REFERENCE MANUAL

T-BERD 209A

T-CARRIER ANALYZER

Telecommunications
Techniques
Corporation

A DYNATECH COMPANY

. . . EXPECT EXCELLENCE

IMPORTANT

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Rev. K

T-BERD 209A
T-CARRIER ANALYZER

REFERENCE MANUAL

June 1992

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SECTION 1
GENERAL INFORMATION

GENERAL INFORMATION

1.1 INTRODUCTION

The purpose of this reference manual is to provide information about the physical features, functional operation, and specifications of the Telecommunications Techniques Corporation (TTC) T-BERD 209A T-Carrier Analyzer.

In addition to this manual, a *T-BERD 209A User's Guide* provides information on setting up and operating the T-BERD 209A in a number of in-service and out-of-service applications.

1.2 INSTRUMENT OVERVIEW

The T-BERD 209A is a portable and comprehensive test instrument for the installation and maintenance of T1 and T1C transmission systems. Designed primarily for central office testing, the T-BERD 209A can be used during circuit installation, acceptance testing, and troubleshooting test applications. The T-BERD 209A can receive and generate test patterns during out-of-service circuit tests or can monitor T1 and T1C circuits without service interruption. The T-BERD 209A can emulate network devices, such as Network Interface Units (NIUs) or Channel Service Units (CSUs). In addition, the instrument can detect and isolate circuit problems with customer premises and network equipment.

1.3 STANDARD FEATURES

D4, ESF, and SLC™-96 framing patterns offer compatibility with a variety of framing formats. An unframed mode is also available for applications where framing is not required.

Summary test results category displays key non-zero and out-of-specification results, eliminating the need to search through long lists of test results.

Automatic configure mode lets the T-BERD 209A configure itself to the proper line rate (T1 or T1C), framing, coding, and pattern. No set up is required when monitoring live circuits.

Simultaneous logic error, bipolar violation, and frame error analysis is performed along with associated error rate, errored second, and percent error-free second calculations.

Automated BRIDGTAP™ test allows the T-BERD 209A to evaluate a T1 span for bridge taps. The test automatically generates 21 test patterns which are monitored for errors. The T-BERD 209A displays and generates a printout of the cumulative test results and which patterns experienced one or more bit errors on the front panel.

Automated MULTIPAT™ test generates five standard T1 test patterns in 15 minutes, that eliminates the need to perform individual tests with each pattern. The T-BERD 209A displays and generates a printout of the cumulative test results and which patterns experienced one or more bit errors on the front panel.

Signal analysis with simplex current, signal level, timing slip, and recovered clock frequency measurements.

Slips and wander measurements identify wander impairments or the potential for frame slips.

Pulse shape analysis allows you to measure the height, width, rise time, fall time, overshoot and undershoot of a T1 pulse. Pulse shapes can also be measured for conformance to AT&T Compatibility Bulletin 119 or ANSI T1.403 Network Interface specifications.

Logic, BPV, and frame error insertion enables the T-BERD 209A to simulate errors as they occur. Errors may be inserted singly, in a burst, or at variable rates.

RS-232 printer/remote control interface allows you to print graphic displays (e.g., pulse shapes) and error analysis results, and to remotely control the T-BERD 209A.

Results history buffer stores up to six sets of your most recent test results that can be viewed from the front panel.

1.4 OPTIONS

G.821 Performance Analysis Option — Option 209A-1

CCITT Recommendation G.821 performance analysis evaluates the long-term performance of your system.

Adds unavailable second, percent availability, degraded minute, percent degraded minute, and severely errored second results to the LOGIC category.

Rechargeable Lead-Acid Battery Option — Option 209A-2

Provides battery backup when AC power is lost.

Provides continuous battery operation when AC power is not available.

Operates up to 5 hours on a single charge.

Continuously charged when AC power is applied.

Energy saver function turns off the display when no switches are pressed for five minutes.

Advanced BERT Option — Option 209A-3

Adds a user programmable 1- to 2000-character hexadecimal test pattern that determines the circuit sensitivity to the pattern when transmitted.

Adds a minimum/maximum density stress pattern that can be used for framed or unframed signal testing.

Adds repeatered span line test patterns that can stress test timing recovery circuits and span-line repeater ALBO circuitry.

Enhanced ESF Option — Option 209A-4

Monitor and reports on the received ESF datalink ANSI T1.403 Performance Report Message (PRM).

Analyzes and generates the PRM for the received T1 signal.

Adds PRM results to the BPV & FRAME and SUMMARY categories.

Transmits and analyzes ZBTSI (Zero Byte Time Slot Interchange) encoded ESF and ESF FT1 (requires the FT1 Option) framed data.

Time Domain Reflectometer Option — Option 209A-5

TDR tests and locates line impairments such as shorts, opens, splices, coils, and bridge taps on twisted-pair copper wire with minimal set-up requirements.

Faults and distances are displayed in plain English for shorts, opens, and bridge taps on the front panel.

Test results, TDR set-up, and fault location trace can be printed in graphic form using the TTC PR-40A Thermal Printer.

Test and identify faults on a cable pair from 100 to 6500 feet.

Printout of a TDR fault trace and distance graph indicates all line impairments detected on the cable pair in a normal and magnified mode.

Printout can show a single trace or compare a test trace to a reference trace.

Fractional T1 Option — Option 209A-6

Fractional T1 (FT1) modes provide contiguous and noncontiguous, 56xN and 64xN, fractional T1 testing capabilities in D4, ESF, and ESFz framing formats. The FT1 ESFz mode requires both the Enhanced ESF and Fractional T1 Options.

T-BERD DLC Analyzer Option — Option 209A-96 (Model 42170)

Tests circuits that have either T1 D4, T1 D1D, T1 ESF, or T1 SLC-96 framing.

Drops and inserts SLC-96 datalink and T1 channel information.

SLC-96 datalink major, minor, and power/miscellaneous alarms are reported on the front panel and can be generated to test terminal alarm circuits.

Automated maintenance test procedure can be initiated from the T-BERD DLC Analyzer.

Far-end loopbacks can be established over a given shelf or protection line. The selected shelf is automatically switched to the protection line when placed in loopback.

Switch to protection line can be initiated for a given shelf.

On-hook, off-hook, and ringing conditions can be generated from dedicated switches.

A, B, C, and D channel signaling bits can be monitored on all channels or timeslots simultaneously.

SLC-96 Mode 2 timeslot channel assignments can be requested and displayed on the front panel.

VF outputs enable DS0 channels or timeslots to be analyzed by external TIMS test sets or listened to over a built-in speaker.

VF signal level and frequency can be measured for individual DS0 channels or timeslots.

404, 1004, and 2804 Hz tones can be inserted into individual DS0 channels or timeslots.

Decodes DTMF dialing sequences and displays the dialed number of the received signal.

2-wire VF input/output enables two-way testing over a selected DS0 channel or timeslot.

T-BERD T1 Channel Monitor Option — Model 40849

Monitor VF channels while testing T1 ESF, SLC, D3/D4, D2, or D1D signals.

Displays the signaling information for all 24 channels.

Decodes the VF signal and sends it to a built-in speaker and jack.

Displays the VF signal level with a VU meter bargraph.

Output either the ESF or SLC datalink to another test set for further analysis.

Output the selected channel to another test set for further analysis.

Fits in the T-BERD 209A cover.

T-BERD Repeater Power Supply Option – Model 41084

Replaces the CO repeater supply during installation and acceptance testing of a new span.

Measures the voltage and span current on the span.

Provides a network interface connection for the T-BERD 209A to test the network.

1.5 ACCESSORIES

The following accessories aid in the installation, transport, and operation of the T-BERD 209A.

Part No.	Description
10949	DC-to-AC inverter.
10958-01	19" rack mount with a 7" vertical space requirement.
10958-02	19" rack mount with a 9" vertical space requirement.
10959-01	23" rack mount with a 7" vertical space requirement.
10959-02	23" rack mount with a 9" vertical space requirement.
10966	Thermal printer paper (5 rolls).
40644-02	Soft carrying case.
41157	Repeater Extender.
PR-40A	Thermal 40-column graphic printer with cable and carrying case (AC or DC operation).

1.6 CABLES

The following cables provide an interconnection between the T-BERD 209A, other test sets, and the network.

Part No.	Description
10199	15-pin D to 15-pin D (10').
10420	310 plug to 310 plug (10').
10558	310 plug to alligator clips (10').
10559	310 plug to bantam plug (10').
10598	WECO 310 plug to WECO 310 plug (4').
10599	WECO 310 plug to bantam plug (10').
10615	Bantam plug to bantam plug (10').
10648	Bantam plug to alligator clips (10').
10686	15-pin D to RJ45 (10').
30697	WECO 310 plug to mini-test clips (6').

1.7 ORDERING INFORMATION

Contact TTC Customer Service Department at (800) 638-2049 for information on ordering options or accessories.

SECTION 2
INSTRUMENT CHECKOUT AND SERVICE

INSTRUMENT CHECKOUT AND SERVICE

2.1 UNPACKING AND INITIAL INSPECTION

The T-BERD 209A shipping container should be inspected for damage when it is received. If the shipping container or shipping material is damaged, it should be kept until the contents of the shipment have been checked. Procedures for checking the electrical performance of the instrument are given in Section 2.5. If the contents are incomplete, or if the T-BERD 209A does not pass the performance test, notify TTC. If the shipping container is damaged, notify the carrier as well as TTC, and keep the shipping container and materials for the carrier's inspection.

2.2 EQUIPMENT INCLUDED

The following equipment should be present when the T-BERD 209A T-Carrier Analyzer is received and unpacked.

- T-BERD 209A T-Carrier Analyzer
- Power cord
- Operating manual
- Front cover or lid option

2.3 WARNINGS AND CAUTIONS

The following warnings list precautions that must be observed before and during all phases of instrument operation. Failure to comply with these and other specific warnings contained elsewhere in this manual may cause physical harm to the operator and/or damage to the instrument. TTC assumes no liability due to the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis must be connected to an approved three-contact electrical outlet or used with a three-contact adaptor with the grounding wire firmly connected to an electrical ground at the power outlet.

KEEP AWAY FROM LIVE VOLTAGES

Do not remove the instrument from the chassis while the power is applied to the unit.

DO NOT OPERATE IN AN AMBIENT TEMPERATURE ABOVE 122° F (50° C)

Operating this unit in temperatures above 122° F (50° C) can cause damage to the unit.

2.4 POWER REQUIREMENTS

The T-BERD 209A is configured with a 90 to 135 VAC single-phase 48 to 60 Hz power supply. The **AC Power** switch, AC line fuse, and connector are located on the side of the T-BERD 209A.

AC Power Connector — The AC power cord plugs into this three-prong receptacle to provide line voltage to the instrument. The safety ground connection is wired directly to the chassis.

AC Power Cord — This instrument is equipped with a three-conductor AC power cable. The power cord must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adaptor with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet.

AC Line Fuse — The AC line fuse compartment is located between the AC power connector and the **AC Power** switch. A 1 A 250 V Slo-Blo fuse (Littlefuse #218001 or equivalent) provides overload protection for the T-BERD 209A (in black holder). A spare fuse is also located in the compartment (in white holder). Always use the correctly rated fuse. Refer to Section 2.7 for instructions to replace a blown fuse.

AC Power Switch — The switch controls the AC power to the instrument. The switch is labeled with a "1" for the ON position and a "0" for the OFF position. Always place the switch in the OFF position before connecting power. When power is removed, the

front-panel configuration is retained in memory. Pressing the **MODE** switch when power is applied displays the software and hardware revision levels. Pressing the **RESTART** switch when power is applied defaults the instrument configuration to the factory defaults.

Low Battery LED — When the optional lead-acid battery is installed, the LED illuminates approximately 15 minutes before the battery is completely drained of power. The history LED illuminates when the current LED is illuminated and AC power is applied to the instrument. The battery is recharged anytime AC power is applied. The AUX PWR SAVE function can be used to prolong the battery charge by turning the front-panel display off when the switches are not being used. Refer to Section 2.8 for information on caring for the battery.

Power Loss LED — Located on the front panel, the LED illuminates when the T-BERD 209A regains power after a power loss. If a test is in progress at the time of a power loss, the T-BERD 209A is automatically restarted when power is regained. The LED remains illuminated until either the **HISTORY RESET** switch is pressed or a major switch change (e.g, **MODE, PATTERN,** etc.) has occurred. If a printer is connected, a results printout is generated when power is restored.

2.5 INSTRUMENT SELF-TEST/CHECKOUT

Perform the following checkout procedure to verify the operation of the T-BERD 209A.

1. **Front cover or lid option**
   Remove the cover from the T-BERD 209A by unsnapping the metal latches on each side of the instrument. For the standard cover, turn the cover upside down and pull the compartment panel out to access the AC line cord.

2. **AC power cord**
   Insert the AC line cord into the AC receptacle on the T-BERD 209A side panel and plug the other end of the cord into a 115 VAC power source.

   WARNING: **Ground the instrument.** To minimize shock hazard, the instrument chassis must be connected to an electrical ground. The instrument is equipped with a three-conductor AC power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact-to-two-contact adaptor with grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet.

CAUTION: The T-BERD 209A should be operated with a 1 A, 250 V, Slo-Blo fuse (Littlefuse #218001 or equivalent.) Always use correct fuse size.

3. **AC Power switch**

Press this switch to apply power to the T-BERD 209A. When the instrument is powered up, an automatic self-test is initiated testing the following.

- Momentarily illuminates all front-panel and switch LEDs.
- Checks the position of all switches. If a switch is stuck in an active position, the switch is noted in the display.
- The nonvolatile RAM (NOVRAM) is checked and the front-panel switches are restored to the previous settings selected before the last power-down. If any changes are found, the factory default settings are reloaded and the message *RELOAD NOVRAM* is displayed.
- If it becomes necessary to restore all switch settings to the factory defaults, with the power off, press and hold the **RESTART** switch, then turn the power on. Hold the **RESTART** switch down until the message *CALIBRATING* appears in the display. The display and all the LEDs illuminate and the message *RELOAD NOVRAM* appears. Press the **RESTART** switch to take the T-BERD 209A out of self-test. The T-BERD 209A remains fully functional even though the switch settings may not be saved during the power cycle. While the instrument may be used, contact the TTC Customer Service Department at (800) 638-2049.
- The instrument RAM, EPROM, and microprocessor are also checked during the self-test. If any error is found, the messages *BAD RAM, BAD ROM,* or *BAD PROCESSOR* appears. In such instances, contact the TTC Customer Service Department at (800) 638-2049. There are no user-serviceable parts within the T-BERD 209A.

4. **MODE switch**

Press this switch to select the AUX mode.

5. **PATTERN switch**

Press this switch to scroll through the following auxiliary functions and set them as follows:

- HALT/CONT to HALT
- ERR SEL to SINGLE ERROR
- ER RATE to 1.0 E-6

- PLS MASK to DSX
- FRM ERROR to SINGLE ERROR

6. **MODE switch**
   Press this switch until the SELF TST operating mode appears in the MODE window. In self-test mode, the T-BERD 209A transmitter is internally connected to its receiver; ESF framing and internal timing are automatically selected.

7. **PATTERN switch**
   Press this switch until the ALL ONES test pattern appears in the PATTERN window.

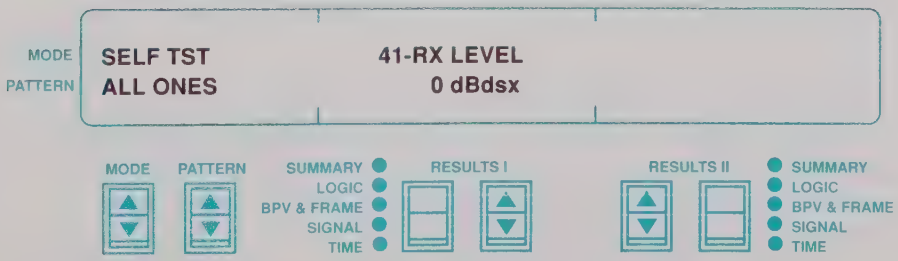
8. **Received signal status and alarm LEDs**
   Ensure that these LEDs illuminate:

   - T1 Pulses
   - Pattern Sync
   - Frame Sync
   - All Ones

9. **RECEIVE INPUT switch**
   Set this switch to TERM.

10. **TRANSMIT OUTPUT switch**
    Set this switch to 0 dB.

11. **RESULTS I switches**
    Press the **RESULTS I Category** switch to select the SIGNAL category. Press the **RESULTS I Results** switch to scroll through the results until the 41-RX LEVEL test result appears. The value for this result should be 0 dBdsx ±0.5 dB.



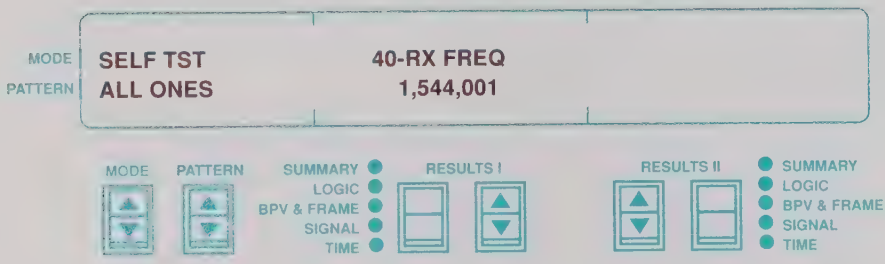
12. **TRANSMIT OUTPUT switch**
    Set this switch to -7.5 dB. Confirm that the 41-RX LEVEL result changes to -7.5 dBdsx ±1.5 dB.

13. TRANSMIT OUTPUT switch

Set this switch to -15 dB. Confirm that the 41-RX LEVEL result changes to -15 dBdsx ±1.5 dB.

14. RESULTS I Results switch

Press this switch to scroll through the results until the 40-RX FREQ test result appears. Confirm that the value for this result is within the range 1,543,999 to 1,544,001 Hz.

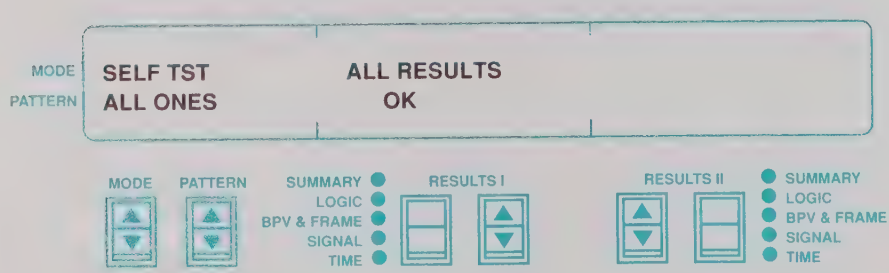


15. RESTART switch

Press and release this switch to restart the T-BERD 209A.

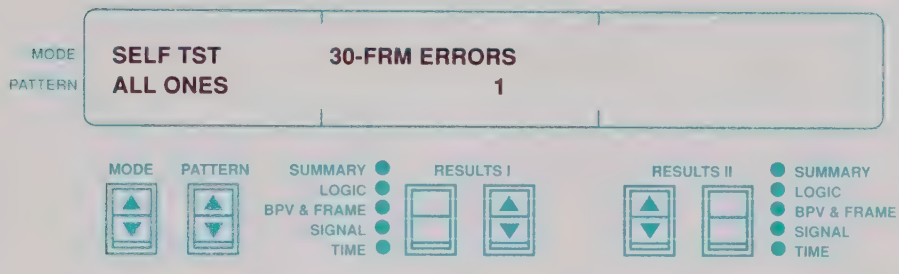
16. RESULTS I Category switch

Press this switch to select the SUMMARY category. The message *ALL RESULTS OK* should appear in the RESULTS I window.



17. FRAME ERROR INSERT switch

Press and release this switch several times to verify that the 30-FRM ERRORS test result appears in the display and increments by one each time the switch is pressed.



18. BPV ERROR INSERT switch

Press and release this switch several times to verify that the 25-VIOLATIONS test result appears in the display and increments by one each time the switch is pressed.

19. TRANSMIT and RECEIVE jacks

Plug a bantam or WECO 310 patch cord into these connectors to loop the TRANSMIT output to the RECEIVE input jacks.

20. MODE switch

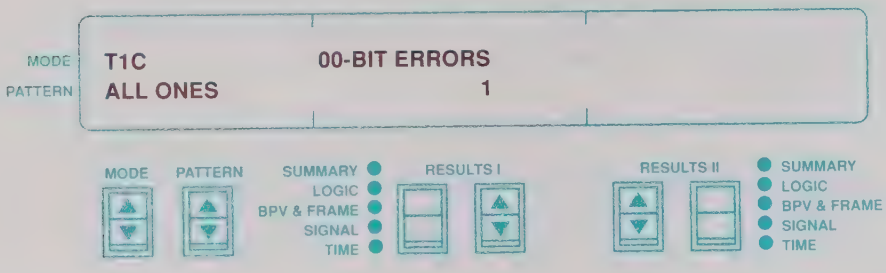
Press this switch until the T1C operating mode appears in the MODE window.

21. TIMING switch

Set this switch to INT.

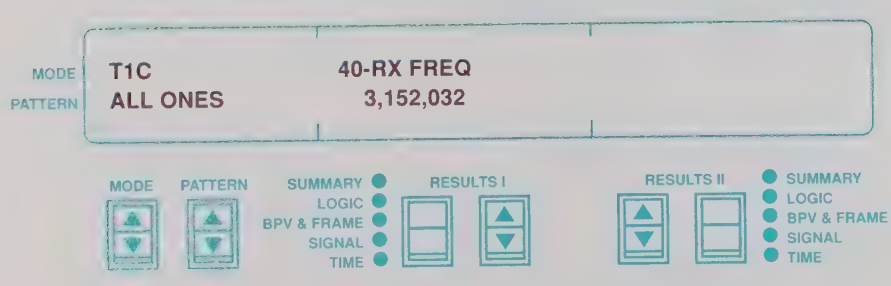
22. LOGIC ERROR INSERT switch

Press and release this switch several times to verify that the 00-BIT ERRORS test result appears in the display and increments by one each time the switch is pressed.



23. **RESULTS I switches**

Press the **RESULTS I Category** switch to select the SIGNAL category. Press the **RESULTS I Results** switch to scroll through the results until the 40-RX FREQ test result appears. Confirm that the received frequency is within the range 3,151,968 to 3,152,032 Hz.



24. **RESTART switch**

Press and release this switch to restart the T-BERD 209A.

25. **LOGIC ERROR INSERT switch**

Press and hold this switch until the switch LED illuminates continuously.

26. **BPV ERROR INSERT switch**

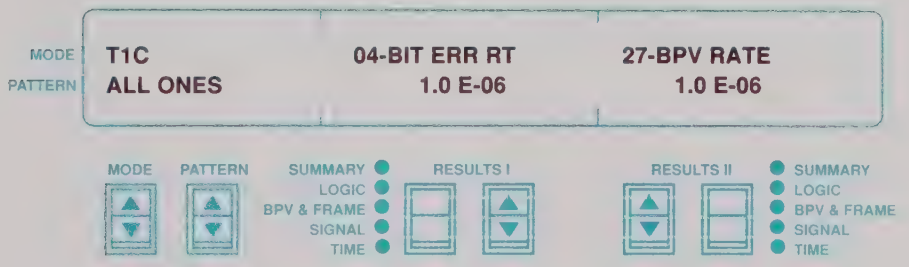
Press and hold this switch until the switch LED illuminates continuously.

27. **RESULTS I and II switches**

Press the **RESULTS I Category** switch to select the LOGIC category. Press the **RESULTS I Results** switch to scroll through the results until the 04-BIT ERR RT test result appears.

Press the **RESULTS II Category** switch to select the BPV & FRAME category. Press the **RESULTS II Results** switch to scroll through the results until the 27-BPV RATE test result appears.

After 10 seconds, both of the displays should show values within the range 9.0 E-07 to 1.1 E-06.



28. RESULTS I switches

If the G.821 Performance Analysis Option is installed in your T-BERD 209A, press the **RESULTS I Category** switch to select the LOGIC category. Press the **RESULTS I Results** switch to scroll through the results to confirm that the following test results are available:

- 10-SEV ERR SEC
- 11-%SEV ER SEC
- 12-DEGR MIN
- 13-%DEGR MIN
- 14-UNAVL SEC
- 15-%AVLBILITY

2.6 IN CASE OF DIFFICULTY

If the T-BERD 209A fails to operate and no front-panel indicators are illuminated:

- Check the AC power cord to ensure that it is securely connected to the T-BERD 209A.
- Make sure that the power supply is uninterrupted by plugging another electrical device into the electrical outlet used by the T-BERD 209A.
- Verify that a proper, working AC line fuse is installed.

If the T-BERD 209A fails to operate after the AC power cord, power supply, and fuse are found to be in proper working order, contact the TTC Customer Service Department at (800) 638-2049.

If the front-panel indicators illuminate, but the instrument does not operate properly, proceed to Section 2.5 to localize the problem. Note the areas where the procedure failed, then contact TTC for assistance at (800) 638-2049.

2.7 AC LINE FUSE REPLACEMENT

The T-BERD 209A AC line fuse is stored in the AC fuse receptacle located just underneath the **AC Power** switch. If the fuse is open, it should be replaced with a 1 A 250 V, Slo-Blo fuse (Littlefuse #218001 or equivalent). Always use the correctly rated fuse.

To replace the AC line fuse, perform the following:

1. **AC Power switch receptacle**
   Locate the small tab to the plastic fuse cover just above the switch.

2. **Open fuse cover**
   Using a small screwdriver or similar instrument, *gently* pry the fuse cover open. The cover is hinged at the bottom.

3. **Replace the fuse**
   Remove the opened fuse in the black holder and install a new fuse of the correct size. There is a spare fuse in the white holder. When returning the fuse holder to the fuse compartment, align the fuse holder arrow with the arrow on the inside of the compartment cover.

4. **Close fuse cover**

   Press down on the cover until it snaps shut. Watch that the cover opening does not catch on the **AC Power** switch.

2.8 BATTERY CARE

The Battery Option provides a rechargeable sealed lead-acid battery. The battery is self-contained and does not need customer servicing. If for some reason the battery does not hold a charge, contact TTC Customer Service at (800) 638-2049 for assistance.

When the Low Battery LED illuminates, the battery can continue to power the T-BERD 209A for approximately 15 minutes. The T-BERD 209A can operate for approximately five hours on a fully charged battery. To fully recharge the battery, connect the AC power to the T-BERD 209A for at least eight hours without turning the instrument on. Whether the T-BERD 209A is on or not, the battery is always being charged.

2.9 AUTO-CALIBRATION PROCEDURE

The T-BERD 209A features an auto-calibration function that allows you to automatically adjust receive level measurement, recovered clock extraction, T1/T1C detectors, and simplex current measurements. It is suggested that auto-calibration be performed once a year to compensate for the normal aging of components.

Auto-calibration is performed by pressing the **DISPLAY HOLD** switch and then applying power to the T-BERD 209A. Keep the **DISPLAY HOLD** switch pressed until the message *CALIBRATING* appears in the display.

NOTE: Auto-calibration should be performed after allowing the unit to warm up at normal room temperature for a period of 30 minutes.

If an error occurs during auto-calibration, an error message appears in the display; in such instances, contact TTC Customer Service Department for assistance at (800) 638-2049.

2.10 WARRANTY

2.10.1 Warranty Policy

All equipment manufactured by TTC is warranted against defects in material and workmanship. This warranty applies only to the original purchaser and is non-transferable unless express written authorization of the warranty transfer is granted by TTC. No other warranty is expressed or implied. TTC is not liable for consequential damages.

Liability under this warranty extends only to the replacement value of the equipment. The warranty is void under the following conditions:

- Equipment has been altered or repaired without specific authorization from TTC.
- Equipment is installed or operated other than in accordance with instructions contained in TTC literature and operating manuals.

2.10.2 In-Warranty Service

Equipment that requires in-warranty service must be returned to the factory with shipping prepaid. The equipment should be packed and shipped in accordance with instructions in Section 2.11. Before returning any equipment, the customer must obtain a Return Authorization (RA) number by contacting the TTC Repair Department at (800) 638-2049. The RA number should then appear on all paperwork and be clearly marked on the outside of the shipping container.

After the equipment is repaired by TTC, it will be tested to applicable specifications, burned-in for at least 24 hours, retested, and returned to the customer with shipping prepaid. A brief description of the work performed and the materials used will be provided on the Equipment Repair Report furnished with the returned equipment.

2.10.3 Out-of-Warranty Service

The procedure for returning and repairing out-of-warranty equipment is the same as for equipment still in warranty. However, there is a minimum charge applied to each request for out-of-warranty service. The minimum charge guarantees the customer an estimate of the repair costs and is used as credit against actual materials and labor costs should the equipment be repaired. Contact the TTC Repair Department at (800) 638-2049 for specific information on the minimum out-of-warranty repair charge.

The customer will be billed for parts plus standard labor rates in effect at the time of the repair. The customer will also be required to furnish a purchase order number before repair work can be started, and a hard copy of the purchase order must be received by TTC before the repaired equipment is shipped to the customer. A description of the labor and materials used will be provided in the Equipment Repair Report.

Once an out-of-warranty repair is made, the repaired part or component is warranted for 90 days. This warranty applies only to the part or component that was repaired; other parts or components are not covered under the 90-day repair warranty.

2.11 EQUIPMENT RETURN INSTRUCTIONS

To all equipment returned for repair, the customer should attach a tag that includes the following information:

- Owner's name and address.
- A list of the equipment being returned and the applicable serial number(s).
- A detailed description of the problem or service requested.
- The name and telephone number of the person to contact regarding questions about the repair.
- The Return Authorization (RA) number.

It is recommended that all switches be left in the positions they were in when the problem occurred. This is requested so that the TTC repair group can analyze the switch positions along with a detailed description of the problem or of the service requested.

If possible, the customer should return the equipment using the original shipping container and material. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit; when needed, appropriate packing materials can be obtained by contacting the TTC Repair Department. TTC is not liable for any damage that may occur during shipping. The customer should clearly mark the TTC-issued RA number on the outside of the package and ship it prepaid and insured to TTC.

SECTION 3
INSTRUMENT DESCRIPTION

INSTRUMENT DESCRIPTION

3.1 INTRODUCTION

This section can be used as a reference during testing and as a guide to understanding the functions of the T-BERD 209A (see Figure 3-1). The controls, indicators, and connections of the mainframe and each of the mainframe options are described in the following order:

- Mainframe
- G.821 Performance Analysis Option
- Advanced BERT Option
- Enhanced ESF Option
- TDR Option
- Fractional T1 Option

Section 4 describes the T1 Channel Monitor, Repeater Power Supply, and DLC Analyzer Lid Options.

The switches, indicators, and connectors are presented in the following functional areas.

Test Setup — Describes the controls and indicators used to configure the T-BERD 209A to test a T1 circuit.

Circuit Connections — Describes the available T-BERD 209A connections and switches used to interface with the circuit being tested.

Signal Verification — Explains the controls, indicators, and test results used to verify that the T-BERD 209A has properly acquired the received signal.

Starting Test/Collecting Results — Describes the T-BERD 209A controls and indicators used to start and run a test; and view, collect, and analyze the test results.

Troubleshooting Controls — Describes the controls used to troubleshoot and test the circuit.

Printer Controls — Explains how to generate printouts manually or automatically.

NOTE: Throughout this section, a circled number appears after each control name. These numbers match the callouts in the figures. Use these numbers to locate switches, indicators, and connectors on the front panel.

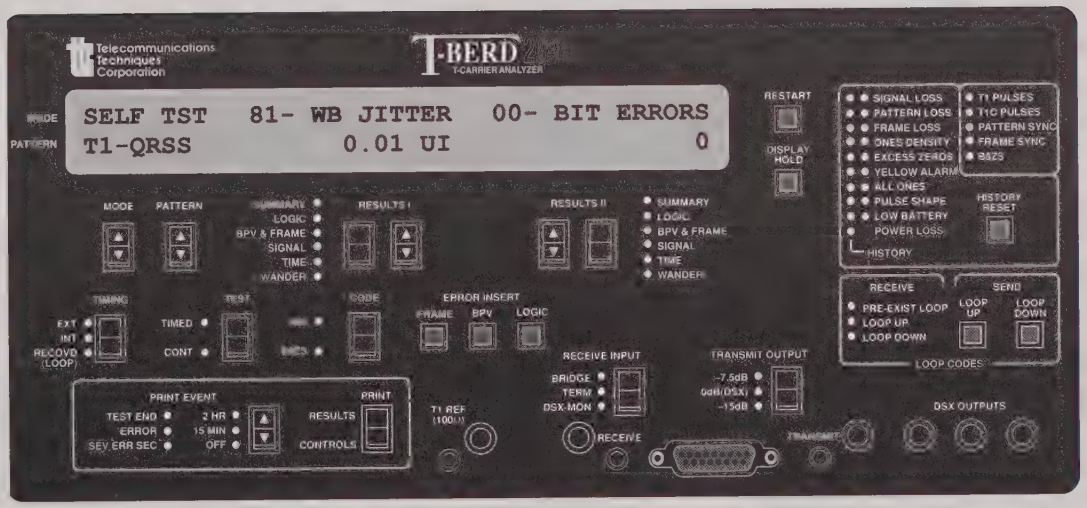


Figure 3-1
T-BERD 209A Front Panel

3.2 MAINFRAME — TEST SETUP

The following controls and indicators (see Figure 3-2) are described in the order that you would normally use them to set up the T-BERD 209A to test a circuit from a DS1 access point.

- Help card
- Front-panel display (1)
- **MODE** switch (2)
- **PATTERN** switch (3)
- **TIMING** switch (4)
- **TEST** switch (5)
- **CODE** switch (6)

Help Card

The pull-out help card furnishes a quick reference to the following information:

- Available mode and pattern selections
- Auxiliary functions
- Available results, grouped by category and sorted by result number
- TDR Option setup parameters

The help card is stored below the front panel. To pull out the card, locate the small tab along the bottom edge of the front panel and slide the card straight out. The card remains attached to the instrument but is hinged so that it folds down for better viewing.

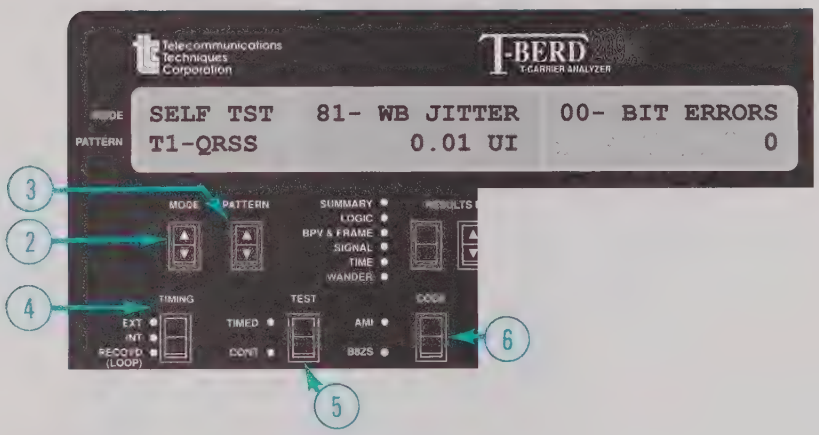


Figure 3-2
Test Setup Controls and Indicators

Front-Panel Display (1)

Operating modes, test results, test patterns, and auxiliary functions appear in the three window, two-line, green fluorescent display.

The first section (left side) indicates the current operating mode (MODE window) and test pattern (PATTERN window) of the instrument. Pressing the **MODE** and **PATTERN** switches selects the displayed information.

The other two sections display the test results, auxiliary functions, and signal detection and operating mode status messages. The middle section is identified as the RESULTS I window, and the right section is identified as the RESULTS II window. The RESULTS I window is controlled by the two **RESULTS I** switches just below the window. The RESULTS II window is controlled by the two **RESULTS II** switches just below the window.

When the auxiliary functions appear, the two windows identify the function of the **RESULTS** switches.

MODE Switch (2)

This switch performs the following functions:

- Selects the framing format (i.e., D4, ESF, SLC, or unframed) and data rate (i.e., T1 or T1C) of the transmitted data and informs the receiver what to expect.
- Configures the T-BERD 209A for Test and Line Loopback modes for CSU or repeater loopback emulation.
- Sets the instrument in a self-test mode to verify instrument operation.
- Selects an auto-configure mode which allows the instrument to automatically configure itself to the received data rate and framing format.
- Provides access to a number of auxiliary functions.

Pressing the **MODE** switch once steps the display between the current operating mode and the AUX mode, and vice versa. The selected operating mode appears in the MODE window immediately above the switch and the instrument configures itself to the selected mode. The selected operating mode remains in effect until another operating mode is selected. When the AUX mode is displayed, the auxiliary functions are accessible, and the previously selected operating mode also remains in effect.

Pressing the **MODE** switch quickly two or more times skips the AUX mode and allows another operating mode to be selected. Holding the **MODE** switch scrolls the operating and AUX modes in the display. Releasing the **MODE** switch on a displayed mode or AUX selects that mode.

NOTE: With the exception of AUX mode, changing modes causes a test restart after the **MODE** switch is released.

With the exception of the AUX mode, the following operating modes are listed in factory default order.

SELF TST — Self-Test mode configures the T-BERD 209A in a self-test loopback mode that loops the transmit output to the receive input. The data is transmitted at the T1 rate with ESF framing. The **TIMING** switch is automatically set for INTernal timing in the SELF TST mode. When leaving SELF TST mode, the **TIMING** switch reverts to its previous position. Any test pattern can be selected but ALL ONES is recommended.

AUTO — Automatic configure mode enables the T-BERD 209A to automatically configure itself to the received line rate and framing format when monitoring live data. When auto-configuration is successful, both the received framing mode and pattern (only if the signal is recognized as a pattern) appear in lower-case characters in the MODE and PATTERN windows. When the received signal is not recognized as a pattern, the word *live* appears in the PATTERN window.

T1 — T1 Unframed mode configures the T-BERD 209A to transmit and receive unframed T1 data to test T1 unframed circuits.The **FRAME ERROR INSERT** switch is disabled in this mode.

T1 D4 — T1 D4 Superframe mode configures the T-BERD 209A to transmit and receive D4 framed T1 data to test D4 framed circuits. This mode can also be used to test D1D, D2, and D3 framed circuits.

T1 ESF — T1 Extended Superframe mode configures the T-BERD 209A to transmit and receive ESF framed T1 data to test ESF framed circuits. For loopback testing, the AUX ESF LOOP function provides in-band and ESF out-of-band loop code transmission capabilities in this mode.

T1 SLC — T1 Subscriber Loop Carrier mode configures the T-BERD 209A to transmit and receive SLC framed T1 data to test SLC-96 framed circuits. The instrument ignores the SLC datalink (F_S) bits in the received signal. The SLC datalink bits are set to all zeros in the transmitted test pattern.

T1 TLB — T1 Test Loopback mode configures the T-BERD 209A into a T1 Test Loopback (TLB) mode in which all received data and framing are echoed by the transmitter. This mode emulates a CSU in loopback.

BPVs *are removed* from the received signal. However, BPVs, logic errors, frame errors, and B8ZS encoding *can be* inserted into the retransmitted data stream using the **ERROR INSERT** and **CODE** switches, respectively. If the received data pattern matches the selected test pattern (i.e., T1-QRSS), pattern synchronization is declared (Pattern Sync LED illuminates) and logic error test results are available.

The **LOOP CODE** and **FRAME ERROR INSERT** (to test ZBTSI encoded data) switches are disabled. The RECEIVE LOOP CODE status LEDs indicate a received loop code (when AUX LP CODE function matches the received loop code), but the T-BERD 209A does not respond to the loop codes. The **TIMING** switch automatically defaults to RECOVD (LOOP) timing.

T1 LLB — T1 Line Loopback mode configures the T-BERD 209A into a T1 Line Loopback (LLB) mode in which all received data and framing are echoed by the transmitter. This mode emulates a repeater.

BPVs *are not removed* from the received signal. If the received data pattern matches the selected test pattern (i.e., T1-QRSS), pattern synchronization is declared (Pattern Sync LED illuminates) and logic error test results are available.

The **LOOP CODE**, **ERROR INSERT**, and **CODE** switches are disabled. However, the RECEIVE LOOP CODE status LEDs indicate a received loop code (when AUX LP CODE function matches the received loop code), but the T-BERD 209A does not respond to the loop codes. The **TIMING** switch automatically defaults to RECOVD (LOOP) timing.

T1C — T1C Unframed mode configures the T-BERD 209A to transmit and receive unframed T1C data to test T1C circuits. When the T1C mode is selected, the **FRAME ERROR INSERT** switch is disabled. When T1C data is received, the T1C Pulses LED illuminates.

T1C TLB — T1C Test Loopback mode configures the T-BERD 209A into a T1C Test Loopback (TLB) mode in which all received data and framing are echoed by the transmitter. This mode emulates a CSU in loopback. The receiver only accepts unframed T1C data in this mode.

BPVs *are removed* from the received signal. However, BPVs, logic errors, frame errors, and B8ZS encoding *can be* inserted into the retransmitted data stream using the **ERROR INSERT** and **CODE** switches, respectively. If the received data pattern matches the selected test pattern (i.e., T1-QRSS), pattern synchronization is declared (Pattern Sync LED illuminates) and logic error test results are available.

The **LOOP CODE** and **FRAME ERROR INSERT** (to test ZBTSI encoded data) switches are disabled. The RECEIVE LOOP CODE status LEDs indicate a received loop code (when AUX LP CODE function matches the received loop code), but the T-BERD 209A does not respond to the loop codes. The **TIMING** switch automatically defaults to RECOVD (LOOP) timing.

Auxiliary Functions

Auxiliary functions allow access to selectable functions and parameters that are less frequently used and do not have dedicated switches. When the AUX mode is selected, the selected auxiliary function is identified in the PATTERN window. The displayed test results in the RESULTS I and RESULTS II windows are also replaced by the auxiliary function parameters. Pressing the **PATTERN** switch scrolls the available auxiliary functions in the display.

The **RESULTS** switches provide control over the auxiliary function parameter displayed above them. Note that the use of these switches varies with each auxiliary function.

Table 3-1 lists the mainframe auxiliary functions available through the AUX mode. The auxiliary functions are described in detail in Section 5.

Table 3-1
Auxiliary Functions

Displayed Name	Description
AUX USER1	User 1 Programmable Test Pattern
AUX USER2	User 2 Programmable Test Pattern
AUX RESPONSE	Loop Code Response Function
AUX PGM LPUP	Programmable Loop-up Code
AUX PGM LPDN	Programmable Loop-down Code
AUX BAUD	RS-232 Printer/Remote Control Baud Rate Select
AUX PARITY	RS-232 Printer/Remote Control Parity Select
AUX HALT/CONT	Action on Pattern Synchronization Loss
AUX PRNT FMT	Results Printout Format
AUX TERM	RS-232 Printer/Remote Control Line Terminator
AUX PLS MASK	Pulse Shape Measurement Mask Select
AUX RES HIST	Results History Buffer
AUX HIST CLR	Clear History and Printer Buffers
AUX ERR SEL	BPV and Logic Error Burst Duration Select
AUX FRM ERR	Frame Error Insertion Select
AUX ER RATE	BPV and Logic Error Insertion Rate
AUX CLOCK	Set Clock Time
AUX DATE	Set Date
AUX TEST LEN	Set Timed Test Length Duration
AUX GRAPH	Print Graph Function
AUX LP CODE	Loop Code Select
AUX ESF LOOP	ESF Loop Code Select

PATTERN Switch (3)

This switch selects the data pattern to be transmitted and informs the receiver which data pattern to expect. Press the **PATTERN** switch to scroll through the available data patterns; the test pattern names appear in the PATTERN window. Select a test pattern by releasing the switch when the desired pattern appears in the display. Changing the test patterns always restarts the T-BERD 209A.

All patterns can be used in any framed and unframed operating mode. The patterns are not transmitted in the T1 TLB, T1 LLB, or T1C TLB modes, but the displayed pattern must match the received test pattern to obtain logic results.

When in-band loop codes are transmitted, the transmitted test pattern is temporarily disabled and the loop code name temporarily replaces the test pattern name in the PATTERN window. When loop code transmission is terminated, the test pattern is enabled and the name reappears in the display. When an ESF out-of-band loop code is transmitted, the test pattern is unaffected.

The following test patterns are listed in factory default order.

ALL ONES — All ones pattern is a fixed test pattern of AMI pulses (Mark). ALL ONES is generally used to stress span repeater current regulator circuits. It can be used as an Alarm Indication Signal (AIS) in unframed circuits, a keep alive signal, idle code, or Red alarm in other circuits. The pattern is required to measure the signal power level in dBm.

1:1 — Alternating ones and zeros pattern is a fixed test pattern of alternating AMI ones (Mark) and zeros (Space) pulses. 1:1 is generally used to perform a minimum level stress test on clock recovery circuits.

1:7 — One and seven zeros pattern is a fixed test pattern of F01000000... The pattern is aligned with the framing (F) bits as indicated. 1:7 is generally used to stress the ones density requirement for T1 circuits.

2 IN 8 — Two ones in eight-bits pattern is a fixed test pattern of F0100 0010... The pattern is aligned with the framing (F) bits as indicated. 2 IN 8 is generally used to test mis-optioned equipment for B8ZS encoding.

3 IN 24 — Three ones in 24-bits pattern is a fixed test pattern of F0100 0100 0000 0000 0000 0100... The pattern is aligned with the framing (F) bits as indicated. This pattern provides the minimum ones density and the maximum excess zeros required to stress T1 circuits. When the pattern is framed, it violates the minimum ones density requirements.

T1-QRSS — T1 Quasi-Random Signal Source pattern simulates live data for T1 applications. This pattern is a modified 2^{20}-1 pseudorandom pattern that allows a maximum of 14 sequential zeros and 20 sequential ones. This pattern can be used for T1C testing.

T1C-QRSS — T1C Quasi-Random Signal Source pattern simulates live data for T1C applications. This pattern is a 2^{20}-1 pseudorandom pattern that allows a maximum of 19 sequential zeros and 20 sequential ones; there is no zero suppression. This pattern can be used for T1 testing.

2^15-1 — 32,767-bit pseudorandom pattern is a pseudorandom pattern that generates a maximum of 14 sequential zeros and 15 sequential ones. The pattern provides a maximum number of zeros allowed for framed, non-B8ZS testing. The pattern does not meet the minimum ones density requirement.

2^20-1 — 1,048,575-bit pseudorandom pattern is a pseudorandom pattern that generates a maximum of 19 sequential zeros and 20 sequential ones. The pattern exceeds excess zeros and does not meet the minimum ones density requirements for T1 applications.

2^23-1 — 8,388,607-bit pseudorandom pattern is a pseudorandom pattern that generates a maximum of 22 sequential zeros and 23 sequential ones. The pattern exceeds excess zeros and does not meet the minimum ones density requirements for T1 applications.

BRIDGTAP — Bridge tap detection test pattern determines if bridge taps are connected to a T1 span by sequentially testing the span with 21 test patterns that have a variety of ones and zeros densities. The T-BERD 209A monitors the received test pattern for bit errors, BPVs, and frame errors. If signal errors are not detected, the span does not have a bridge tap connected to it. However, if signal errors are detected, the span may have one or more bridge taps connected to it and further sectionalization is required.

The 21 test patterns are transmitted continuously in the order shown in Table 3-2. As the patterns are transmitted, the word BRIDGTAP alternates with the name of the test pattern being transmitted The test patterns are identified in the PATTERN window in lower-case characters (e.g., ALL ONES = all ones). One complete BRIDGTAP test pattern sequence takes approximately 10 minutes and 30 seconds to transmit.

The BRIDGTAP pattern is designed to operate with AMI coding to test a span for bridge taps. Using B8ZS encoding redistributes the test pattern energy making it less effective in detecting bridge taps.

Refer to Section 7 for information on the BRIDGTAP results printout.

Table 3-2
BRIDGTAP Patterns

Pattern Name	Bit Pattern
ALL ONES	F 1111
1:1	F 1010
1:3	F 0100
1:5	F 0100 00
1:6	F 0100 000
1:7	F 0100 0000
2:8	F 1100 0000 00
2:9	F 1100 0000 000
2:10	F 1100 0000 0000
2:11	F 1100 0000 0000 0
2:12	F 1100 0000 0000 00
2:13	F 1100 0000 0000 000
2:14	F 1100 0000 0000 0000
3 IN 18	F 1101 0000 0000 0000 00
3 IN 19	F 1100 1000 0000 0000 000
3 IN 20	F 1100 0100 0000 0000 0000
3 IN 21	F 0100 0100 0000 0000 0000 1
3 IN 22	F 0100 0100 0000 0000 0000 10
3 IN 23	F 0100 0100 0000 0000 0000 100
3 IN 24	F 0100 0100 0000 0000 0000 0100
T1-QRSS	2^{20}-1 pseudorandom pattern with 14-zero suppression

F = Framing bit is shown in its relative position to the test pattern.

MULTIPAT — Automated multipattern test generates five commonly used test patterns that allow the T-BERD 209A to test a T1 span without having to select each test pattern individually. The T-BERD 209A monitors the received test patterns for bit errors, BPVs, and frame errors.

The five test patterns are transmitted continuously in the order shown in Table 3-3. As the patterns are transmitted, the word MULTIPAT alternates with the name of the test pattern being transmitted The test patterns are identified in the PATTERN window in lower-case characters (e.g., ALL ONES = all ones). One complete MULTIPAT test pattern sequence takes approximately 15 minutes to transmit.

Refer to Section 7 for information on the MULTIPAT results printout.

Table 3-3
MULTIPAT Patterns

Pattern Name	Bit Pattern
ALL ONES	F 1111
1:7	F 0100 0000
2 IN 8	F 0100 0010
3 IN 24	F 0100 0100 0000 0000 0000 0100
T1-QRSS	2^{20}-1 pseudorandom pattern with 14-zero suppression

F = Framing bit is shown in its relative position to the test pattern.

USER1 and USER2 — User 1 and User 2 programmable bit pattern provides the ability to transmit a 3- to 24-bit user programmable test pattern. This allows the T-BERD 209A to transmit specific bit patterns to test circuit sensitivity to a particular pattern. The pattern is entered in binary form through the AUX USER1 and AUX USER2 functions (see Section 5). The pattern is transmitted starting from left to right in the AUX USER function display.

ALL ZERO — All zeros pattern allows the T-BERD 209A to test T1 circuits for B8ZS or ZBTSI (optional) clear channel capability (CCC). The pattern can be transmitted framed or unframed, and should always be transmitted with B8ZS encoding selected or with the T1 ESFz mode selected.

When using the ALL ZERO pattern and B8ZS encoding, the T-BERD 209A can test a circuit for spans that are not configured for or are incompatible with B8ZS encoded data by monitoring the received signal for the normal B8ZS sequence, 000V 10V1 (where V is a bipolar violation). However, if the T-BERD 209A receives the B8ZS sequence in an alternate mark inversion (AMI) format (0001 1011), instead of all zeros (0000 0000) after decoding, the T-BERD 209A reports the sequence as an error. The message *NOT B8ZS COMPATIBLE* also appears in the SUMMARY category. The failure of the network to maintain the B8ZS sequence in the received ALL ZERO pattern can occur at a multiplexer or DSX with an improperly set coding option; the coding option would be set for AMI instead of B8ZS.

When the T-BERD 209A is set for B8ZS encoding and testing B8ZS compatible circuits, the Excess Zeros LEDs (current and history) illuminate when the T-BERD 209A detects eight or more consecutive zeros in any operating mode and pattern. The Excess Zeros LEDs operate normally when testing AMI encoded T1 circuits.

TIMING Switch (4)

This three-position switch selects the transmit timing source. The labeled LEDs, EXT, INT, and RECOVD (LOOP), illuminate showing the current position of this switch. In Self-Test mode, timing is automatically set to INT regardless of the current setting. In T1 TLB, T1 LLB, AUTO LLB, and T1C TLB modes, timing is automatically set to RECOVD regardless of the current setting of the **TIMING** switch.

EXT — External transmit timing is taken from either the external clock source attached to the EXT CLK IN BNC connector on the right side or from the T1 REF input on the front panel as follows:

- When the EXT CLK IN timing is present and the T1 REF (TDR) timing is not present, the external clock source is taken from the EXT CLK IN timing source.
- When the EXT CLK IN timing is not present and the T1 REF (TDR) timing is present, the external clock source is taken from the T1 REF (TDR) timing source.
- When the EXT CLK IN timing and the T1 REF (TDR) timing are present, the external clock source is taken from the EXT CLK IN timing source.
- When the EXT CLK IN timing and the T1 REF (TDR) timing are not present, the EXT LED flashes.

INT — Internal crystal-controlled oscillator generates the timing source for the transmitted data at either the T1 or T1C rate (selected by the **MODE** switch).

RECOVD (LOOP) — Recovered transmit timing source is taken from the clock signal recovered from the received data. When choosing recovered timing in any T1 mode (except for T1 TLB or T1 LLB), jitter is removed from the clock signal before it is used as the transmit clock source.

TEST Switch (5)

This two-position switch controls the test duration. The CONTinuous position enables unlimited test duration. The TIMED position allows a timed test of up to 200 hours and 59 minutes to be conducted. Changing from CONTinuous to TIMED causes a test restart; however, changing from TIMED to CONTinuous allows the test to continue (i.e., test results continue to accumulate). Refer to the AUX TEST LEN function to set the timed test duration (see Section 5).

CODE Switch (6)

This two-position switch determines whether the T-BERD 209A transmits AMI-encoded data or B8ZS clear-channel encoded data. The LEDs adjacent to this switch illuminate indicating the current selection. The **CODE** switch only affects the transmitter; B8ZS decoding is performed automatically on the receiver. The B8ZS LED illuminates when zero substitution codes are detected. When B8ZS encoding is detected in instances where the **CODE** switch is set to the AMI position, the message *B8ZS DETECTED* appears in the SUMMARY category.

3.3 Mainframe — CIRCUIT CONNECTIONS

The following connections and switches are used to connect the T-BERD 209A to the circuit being tested. The DS1 signal connections are provided on the front panel as shown in Figure 3-3.

- RECEIVE jacks (7)
- **RECEIVE INPUT** switch (8)
- TRANSMIT jacks (9)
- **TRANSMIT OUTPUT** switch (10)
- DSX OUTPUT jacks (11)
- Network Interface Connector (12)
- T1 REF (TDR) jacks (13)
- EXT CLK IN Connector

WARNING: If any of the T-BERD 209A connectors are connected to a simplex-powered span line, the line voltage is also present at the other connections. Therefore, do not use the other connections.

RECEIVE Jacks (7)

Three receive input connectors allow either a WECO 310 jack, a bantam jack, or a 15-pin D connector to receive the input signal. Use the **RECEIVE INPUT** switch to set the line termination for the connection. These connectors also provide the simplex current path to the TRANSMIT jacks.

NOTE: Only use one connector at any given time.

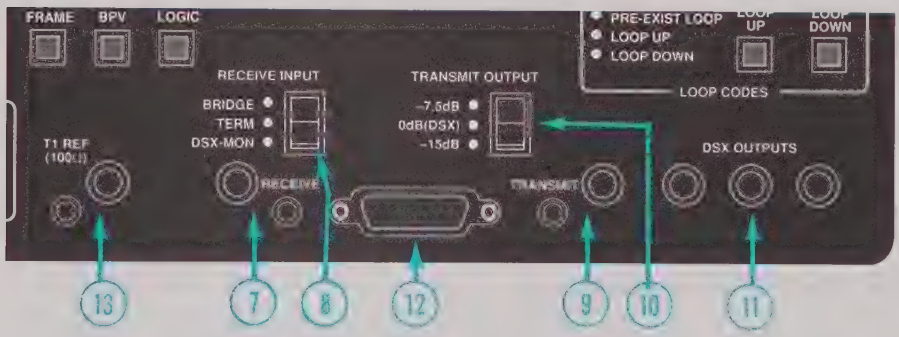


Figure 3-3
Front-Panel Connections

RECEIVE INPUT Switch (8)

This three-position switch selects the input impedance and signal conditioning for the RECEIVE jacks. Changing the **RECEIVE INPUT** switch position causes a test restart.

BRIDGE — Provides an input impedance greater than 1000 ohms for bridging lines that are already terminated. This setting provides Automatic Line Build-Out (ALBO) compensation for cable losses of up to 35 dB for T1 and 6 dB for T1C lines. This is useful for bridging directly across copper cable pairs.

TERM — Provides an input impedance of 100 ohms. This setting provides ALBO compensation for cable losses of up to 35 dB for T1 and 6 dB for T1C lines. This is useful for terminating a circuit with the T-BERD 209A.

DSX-MON — Provides both 100 ohms of input impedance and compensation for resistive loss. This setting is useful for monitoring T1/T1C lines at DSX monitor points which are resistor-isolated. When ALBO is not desired, the line can be terminated with this selection.

TRANSMIT Jacks (9)

Three primary transmit output connectors allow either a WECO 310 jack, a bantam jack, or a 15-pin D connector to transmit an output signal to the circuit being tested. Use the **TRANSMIT OUTPUT** switch to set the output level. These connectors also provide the simplex current path to the RECEIVE jacks.

NOTE: Only use one connector at any given time.

TRANSMIT OUTPUT Switch (10)

This three-position switch allows emulation of three different LBOs for T1 rates: -7.5dB, 0dB (DSX), and -15dB. The LBO circuit (T1 only) inserts artificial line sections with either 7.5 or 15 dB of loss at 772 kHz or bypasses the artificial lines, presenting a DSX-level output. The selected cable loss affects the transmit data only at the 15-pin D connector, and the TRANSMIT bantam and 310 jacks; the DSX OUTPUTS are unaffected. When the **MODE** switch is set to T1C, the 0dB (DSX) position is automatically selected.

DSX OUTPUTS Jacks (11)

Three WECO 310 jacks provide additional DSX-level transmit outputs. Each output provides a 3-volt base-to-peak output into a 100-ohm load. All three outputs can be used simultaneously; however, the TRANSMIT jacks should always be used first.

Network Interface Connector (12)

This female, 15-pin D connector allows connection to the CSU or local loop. A 15-pin male-to-male cable is used to connect to the customer side of the CSU or to the local loop network interface connector. The connector is used in lieu of the TRANSMIT and RECEIVE jacks. Refer to Section 9 for the connector pin assignments. This connection is also used by the Lid Options (see Section 4).

T1 REF (TDR) Jacks (13)

T1 REF (TDR) provides WECO 310 and bantam jacks for two functions: T-Carrier reference clock input and TDR connection. The jacks provide a 167-ohm termination.

T1 Reference Clock Input — Provides a T-Carrier reference clock input to measure timing slips and wander. The input accepts resistively attenuated signals from +6 to -24 dBdsx (DSX MON jack or T-BERD 209A DSX OUTPUT jack). It can also be used as an external timing source input when the **TIMING** switch is set to EXT.

TDR — Provides a connection for the time domain reflectometer (TDR) to test a cable pair for shorts, opens, bridge taps, etc. The TDR Option must be installed and the TDR mode selected from the **MODE** switch to test for faults. Refer to Section 3.21 for additional information on setting up and operating in the TDR mode.

EXT CLK IN Connector

This BNC connector is used to input an external clock source. This clock source can be selected and used to generate data when the **TIMING** switch is set to EXT. A reference clock for timing slips can also be input on this connector. This input is AC coupled and has a 50-ohm input impedance.

3.4 MAINFRAME — Signal Verification

The following controls, indicators, and results are used to verify that the T-BERD 209A has properly acquired the received DS1 signal (see Figure 3-4).

- Signal Status LEDs (14)
- Signal Alarm LEDs (15)
- **HISTORY RESET** switch (16)
- SUMMARY category

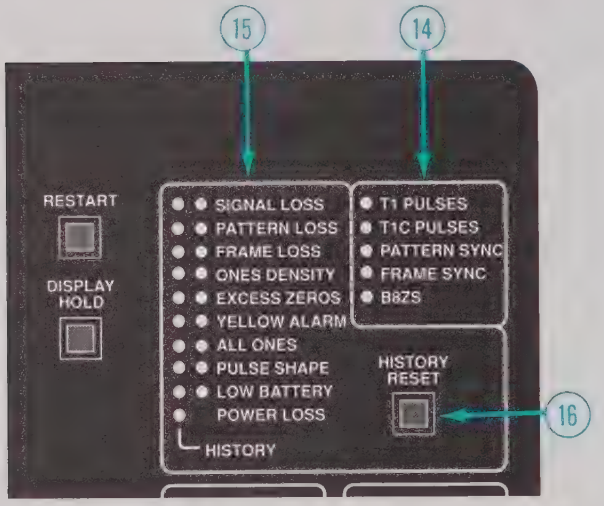


Figure 3-4
Signal Verification Indicators

Signal Status LEDs (14)

The green LEDs illuminate for at least 100 ms providing the status and type of signal being received. The following describes the LEDs:

T1 Pulses — Illuminates when a valid T1 signal is detected at the RECEIVE input connector. If the received signal is lost, the LED goes out and the Signal Loss LED illuminates.

T1C Pulses — Illuminates when a valid T1C signal is detected at the RECEIVE input connector. If the received signal is lost, the LED goes out and the Signal Loss LED illuminates.

Pattern Sync — Illuminates when pattern synchronization is achieved. Synchronization to a fixed pattern (ALL ONES, 1:1, 1:7, 3 IN 24, and two user-programmable patterns) is declared when 30 consecutive error-free bits are received. Synchronization to a pseudorandom pattern is declared upon the reception of 30 + n consecutive error-free bits for a pattern length of 2^n-1 (for the QRSS patterns, n = 20). If pattern synchronization is lost, the LED goes out and the Pattern Loss LED illuminates.

Frame Sync — Illuminates when the T-BERD 209A achieves synchronization to the selected framing format within the T1 data stream. The selected framing pattern is based on the currently selected mode (i.e., T1 D4, T1 ESF, T1 SLC, T1 TLB, or T1 LLB). In T1 TLB and T1 LLB modes, the T-BERD 209A automatically determines the framing type and configures itself to accept either unframed data, D4-framed data, ESF-framed data, or SLC-framed data. If frame synchronization is lost, the LED goes out and the Frame Loss LED illuminates.

B8ZS — Illuminates when B8ZS clear channel encoding is detected in the received T1 or T1C signal. When B8ZS encoding is detected when the **CODE** switch is set to AMI, the message *B8ZS DETECTED* appears in the SUMMARY category.

Signal Alarm LEDs (15)

The two columns of red LEDs illuminate on the occurrence of specific alarm conditions. When an alarm condition first occurs, the current alarm LEDs illuminate for at least 100 ms. After the current alarm condition is cleared (e.g., pattern sync reestablished), the history alarm LEDs illuminate indicating the alarm condition occurred sometime during the test. The alarm LEDs are described as follows:

Signal Loss — Illuminates when no pulses are detected for 150 ms. When the DS1 pulses are detected again, the LED goes out, and the associated History LED and the T1 Pulses (or T1C Pulses) LED illuminates.

Pattern Loss — Illuminates whenever 250 bit errors are counted in 1000 or less data bits, thereby signaling a loss of pattern synchronization. When pattern synchronization is reacquired again, the LED goes out, and the associated History LED and the Pattern Sync LED illuminates.

Frame Loss — Illuminates when 2 out of 5 F_t bits are detected in error for D4 or SLC-96 framing, or when 2 out of 5 framing bits are detected in error for ESF or ESFz framing. When frame synchronization is reacquired, the LED goes out, and the associated History LED and the Frame Sync LED illuminates.

Ones Density — Illuminates when the received data contains less than n ones in 8(n+1) bits, where n = 1 to 23. This conforms with the pulse density criteria specified in AT&T Technical Reference PUB62411 and ANSI T1.403 Network Interface specifications. Note that the 2^15-1, 2^20-1, 2^23-1, and framed 3 IN 24 test patterns all cause this LED to illuminate.

Excess Zeros — When using AMI coding, the LED illuminates when 16 or more consecutive zeros are detected in T1 modes, or when 34 or more consecutive zeros are detected in T1C modes. When using B8ZS encoding, the LED illuminates when eight or more zeros are detected.

Yellow Alarm — Illuminates when bit 2 of each DS0 channel has been forced to a zero for D4 or SLC-96 framing, or when the yellow alarm pattern (0000 0000 1111 1111 ...) is detected in the ESF or ESFz datalink. This alarm condition only applies to framed T1 signals.

All Ones — Illuminates when 2048 consecutive ones are detected for T1C or unframed T1 signals, or when 256 consecutive DS0 channels contain all ones for T1 framed modes.

Pulse Shape — Illuminates when the pulse shape does not fit within the selected mask (see AUX PLS MASK function, Section 5). Pulse shape measurements are available only when the signal level is 0 dBdsx ±4 dB for BRIDGE and TERM connections, or when the signal level is -20 dBdsx ±4 dB for DSX-MON connections. The LED does not illuminate when the signal level is out of range.

Low Battery LED — When the optional lead-acid battery is installed, the LED illuminates approximately 15 minutes before the battery is completely drained of power. The history LED illuminates when the current LED is illuminated and AC power is applied to the instrument. Refer to Section 2 for more information on this LED.

Power Loss — Illuminates when the T-BERD 209A regains power after a power loss. If a test is in progress at the time of a power loss, the T-BERD 209A is automatically restarted when power is regained. If a printer is connected, a results printout is generated when power is restored.

HISTORY RESET Switch (16) — This pushbutton switch clears the history alarm LEDs. Note that this switch does not restart a test, nor does it affect any of the current LEDs or accumulated test results. This switch is disabled when the **DISPLAY HOLD** switch is activated. The **RESTART** switch also clears the illuminated history alarm LEDs.

SUMMARY Category Messages

The SUMMARY category provides a convenient way to monitor specific results and measurements without having to search through the other categories. The SUMMARY category also provides a number of messages indicating whether the results are in or out of specification.

The SUMMARY category is selected by pressing either the **RESULTS I Category** switch or the **RESULTS II Category** switch. When the category is selected, the appropriate yellow LED illuminates.

During initial acquisition of the received signal, the SUMMARY category should be displayed. The following messages can appear during signal acquisition:

ALL RESULTS OK — Message appears when all summary results are error-free or meet specification boundaries (e.g., RX FREQ Hz and PULSE SHAPE).

ALL RESULTS UNAVAILABLE — Message appears at a test restart when the instrument has not synchronized with the received signal.

When an error is detected, the appropriate test result appears in the SUMMARY category window. Refer to Section 6 for more information on the results that appear in the SUMMARY category.

3.5 MAINFRAME — STARTING TEST/COLLECTING RESULTS

Once the T-BERD 209A is configured and connected to the circuit, use the following switches and indicators to initiate the test and collect the test results. Figure 3-5 illustrates the switches and indicators required to verify the results.

- **RESTART** switch (17)
- **DISPLAY HOLD** switch (18)
- **RESULTS** switches (19)
- Collecting test results

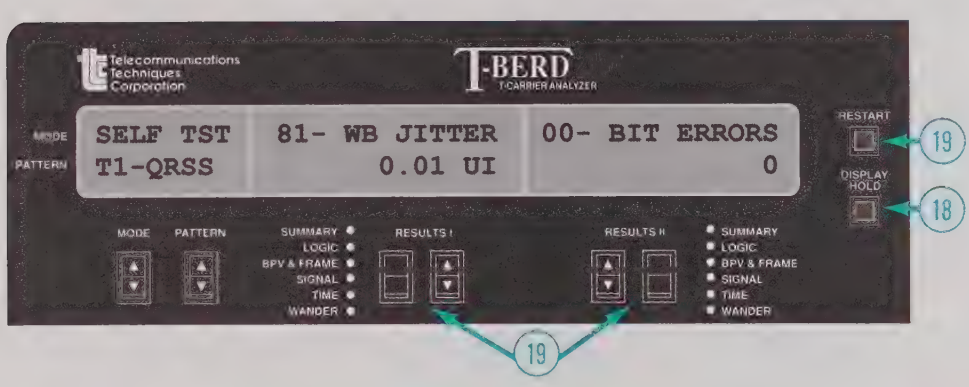


Figure 3-5
Starting Tests and Collecting Results

RESTART Switch (17)

This pushbutton switch restarts any test in progress. When pressed, all test results and history LEDs are cleared. The **RESTART** switch can also be used to exit the AUX mode and reenter the previous mode selection; a restart also occurs.

DISPLAY HOLD Switch (18)

This pushbutton switch freezes the displayed results and alarm and status LEDs at the moment the switch is pressed. When active, the switch LED illuminates indicating that the displayed results are not current. If this switch is pressed again while the LED is illuminated, the test results and LEDs are immediately updated.

RESULTS Switches (19)

When the mode and pattern appear in the MODE/PATTERN window, two results also appear simultaneously in the RESULTS I and RESULTS II windows. The available categories and results are selected with the **RESULTS** switches below the windows.

RESULTS I Category Switch or RESULTS II Category Switch — Selects the category from the list of categories next to the switch. The labeled LEDs illuminate as the category is selected.

RESULTS I Results Switch or RESULTS II Results Switch — Selects the individual results from the indicated category.

Collecting Test Results

During a test, the available results and signal measurements are continuously updated. The results are divided into six categories. The first and most commonly used category is the SUMMARY category. During the initial test setup procedure, the SUMMARY category displays key non-zero or out-of-specification results. Refer to Section 6 for more information on the test results. The available categories and results include:

SUMMARY Category — Lists key results that are non-zero or out-of-specification.

00 - BIT ERRORS	Bit Errors
09 - SLIPS	Pattern Slips
25 - VIOLATIONS	Violations
30 - FRM ERRORS	Frame Errors
32 - CRC ERRORS	CRC Errors
34 - FRM LOS CNT	Frame Loss Count
40 - RX FREQ, Hz	Receive Frequency in Hz
44 - PULSE SHAPE	Pulse Shape
51 - TIMING SLIP	Controlled Timing Slips

LOGIC Category — Lists pattern bit error related results.

00 - BIT ERRORS	Bit Errors
01 - ASYN ER SEC	Asynchronous Error Seconds
04 - BIT ERR RT	Bit Error Rate
05 - ER FREE SEC	Error-Free Seconds
06 - %EFS	% Error-Free Seconds
07 - SYN ERR SEC	Synchronized Error Seconds
08 - OUT SYN SEC	Out-of-Synchronization Seconds
09 - SLIPS	Pattern Slips

BPV & FRAME Category — Lists bipolar violation and frame error related results.

25 - VIOLATIONS	Violations
26 - BPV SECONDS	BPV Seconds
27 - BPV RATE	BPV Rate
28 - FRM ERR SEC	Frame Errored Seconds
29 - FRM SES	Frame Severely Errored Seconds
30 - FRM ERRORS	Frame Errors
31 - FRM ER RATE	Frame Error Rate
32 - CRC ERRORS	CRC Errors
33 - CRC ERR SEC	CRC Errored Seconds
34 - FRM LOS CNT	Frame Loss Count
35 - FRM LOS SEC	Frame Loss Seconds
36 - CRC SES	CRC Severely Errored Seconds
37 - CRC ERR RT	CRC Error Rate

SIGNAL Category — Lists signal (frequency, level, and pulse shape) related results.

40 - RX FREQ, Hz	Receive Frequency in Hz
41 - RX LEVEL (dBdsx)	Receive Level in dBdsx
42 - RX LEVEL (dBm)	Receive Level in dBm
43 - RX LEVEL (Vp-p)	Receive Level in volts
44 - PULSE SHAPE	Pulse Shape
45 - PULSE WIDTH	Pulse Width
46 - RISE TIME	Pulse Rise Time
47 - FALL TIME	Pulse Fall Time
48 - UNDERSHOOT	Undershoot
49 - OVERSHOOT	Overshoot
50 - SPX CURRENT	Simplex Current
51 - TIMING SLIP	Controlled Timing Slips
53 - SLP ANA SEC	Timing Slip Analysis Seconds

TIME Category — Lists time related results.

60 - SIG LOS SEC	Signal Loss Seconds
61 - ALARMED SEC	Alarmed Second
62 - TEST LENGTH	Length of a Timed Test
63 - ELAPSE TIME	Elapsed Time
64 - TEST END IN	Time Remaining in Timed Test
65 - CLOCK TIME	Clock Time of Day
66 - DATE	Date

WANDER Category — Lists wander related results.

70-WANDER +PK	Maximum Positive Wander Peak
71-WANDER - PK	Maximum Negative Wander Peak
72-P-P WANDER	Peak-to-Peak Wander
73-15m WANDER	Maximum Peak-to-Wander Peak Over 15 Minutes
74-24h WANDER	Maximum Peak-to-Wander Peak Over 24 Hours
75-TIE WANDER	Time Interval Error Wander

3.6 MAINFRAME — TROUBLESHOOTING CONTROLS

During T1 circuit testing, it is often necessary to determine the location of problems identified through testing. Figure 3-6 illustrates the troubleshooting controls. Use the following switches to help sectionalize the span.

- **LOOP CODE** switches (20)
- RECEIVE LOOP CODE Status LEDs (21)
- **ERROR INSERT** switches (22)

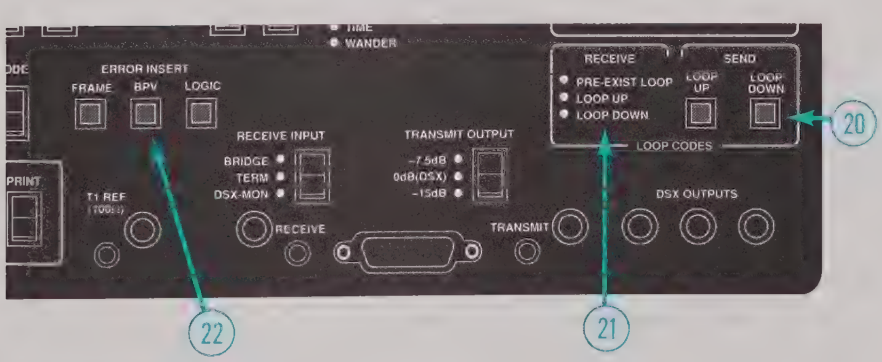


Figure 3-6
Troubleshooting Controls

LOOP CODE Switches (20)

The LOOP CODE control transmits loop-up and loop-down codes (**LOOP UP** and **LOOP DOWN** switches) from the T-BERD 209A to devices that can respond to in-band and out-of-band (ESF datalink) loop codes. This enables the T-BERD 209A to establish an out-of-service loopback anywhere along the span. The RECEIVE loop code LEDs also indicate the type of loop code received by the T-BERD 209A.

The loop code transmitted and responded to by the T-BERD 209A is selected through the following auxiliary functions (see Section 5):

AUX RESPONSE — Determines if the T-BERD 209A responds to the selected loop code and establishes a loopback.

AUX LP CODE — Selects the loop code that is transmitted or responded to by the T-BERD 209A.

AUX ESF LOOP — Determines how loop codes are transmitted or responded to when using either the ESF or ESFz operating mode.

AUX PGM LPUP — Programs the programmable loop-up code.

AUX PGM LPDN — Programs the programmable loop-down code.

The **LOOP CODE** switches and LEDs perform the following functions:

LOOP UP Switch — This pushbutton switch controls the transmission of the loop-up code. The switch LED illuminates for the duration of loop-code transmission. This switch is disabled in T1 TLB, T1 LLB, and T1C TLB modes. When the **LOOP UP** switch is pressed, the loop-up code is continuously transmitted until one of the following conditions occur:

- The loop-up code is detected at the receiver.
- The **LOOP UP** switch is pressed again.
- The **MODE, PATTERN, RESTART, RECEIVE INPUT,** or **TIMING** switch is pressed.

When the **LOOP UP** switch is pressed, the selected loop-up code name appears in the PATTERN window and is transmitted. When the loop code transmission is terminated, the test pattern reappears in the window. If an in-band loop-up code is selected, the transmitted loop code overrides the selected data pattern until one of the previous

conditions occur. If the ESF out-of-band loop code is selected, the loop code is transmitted in the datalink channel and does not overwrite the test pattern.

LOOP DOWN Switch — This pushbutton switch controls the transmission of the loop-down code. The switch LED illuminates for the duration of loop-code transmission. This switch is disabled in T1 TLB, T1 LLB, and T1C TLB modes. When the **LOOP DOWN** switch is pressed, the loop-down code is continuously transmitted until one of the following conditions occur:

- The loop-down code is no longer detected at the receiver.
- The **LOOP DOWN** switch is pressed again.
- The **MODE, PATTERN, RESTART, RECEIVE INPUT,** or **TIMING** switch is pressed.

When the **LOOP DOWN** switch is pressed, the selected loop-down code name appears in the PATTERN window and is transmitted. When the loop code transmission is terminated, the test pattern reappears in the window. If an in-band loop-down code is selected, the transmitted loop code overrides the selected data pattern until one of the previous conditions occur. If the ESF out-of-band loop code is selected, the loop code is transmitted in the datalink channel and does not overwrite the test pattern.

RECEIVE LOOP CODE Status LEDs (21) — These LEDs provide information about loop codes being received by the T-BERD 209A. The following describes the loop-code LED functions.

Pre-Exist Loop — Illuminates when an in-band loop-up code is detected within 1.5 seconds from the start of loop-up code transmission. This LED remains illuminated for 5 seconds. When a pre-existing loop is detected, the transmission of the in-band loop-up code is immediately halted. The LED is disabled when the ESF out-of-band (datalink) loop code is selected.

Loop Up — Illuminates when an in-band or ESF out-of-band loop-up code is received by the T-BERD 209A. The presence of a loop-up code can be detected when the error rate is 10^{-3} or less. It can also be detected with or without the presence of T1 framing.

Loop Down — Illuminates whenever an in-band or ESF out-of-band loop-down code is received by the T-BERD 209A. Like the loop-up code, the presence of a loop-down code can be detected when the error rate is 10^{-3} or less. It can also be detected with or without the presence of T1 framing.

ERROR INSERT Switches (22)

The three **ERROR INSERT** switches, **FRAME**, **BPV**, and **LOGIC**, insert frame errors, BPVs, and logic errors into the data stream individually or simultaneously.

FRAME Switch — Inserts logic errors on the transmitted synchronization bits, i.e., F_t bits in D4 and SLC framing, and Frame Pattern Sequence (FPS) bits in ESF framing.

BPV Switch — Inserts bipolar violations (coding) on any of the transmitted bits, except when the T1 LLB mode is selected. BPVs are inserted without regard to B8ZS encoding. This may cause the same error multiplication (one inserted error causing multiple errors) that occurs on a repeatered span.

LOGIC Switch — Inserts logic errors on any of the transmitted bits, except when the T1 LLB mode is selected. The logic errors are inserted without regard to B8ZS sequences. This may cause the same error multiplication (one inserted error causing multiple errors) that occurs on a repeatered span.

The error insertion duration and rate are selected through the following auxiliary functions (see Section 5):

AUX ERR SEL — Controls logic and BPV error burst duration (single and bursts from 25 ms to 5 sec).

AUX FRM ERR — Controls consecutive frame error insertion (single and 2 to 6 consecutive frame errors) and ESFz errored bit type (frame or Z-Bit).

AUX ER RATE — Controls BPV and logic continuous or burst error rate (from 1.0 E-2 to 9.9 E-9).

The auxiliary functions allow frame errors, BPVs, and logic errors to be inserted in three ways: single error, burst of errors, and continuously. When the **ERROR INSERT** switches are pressed, an internal LED illuminates indicating the error insertion duration selected as follows:

Single Error — Inserted by having the AUX ERR SEL or AUX FRM ERR function set to SINGLE ERROR and pressing the **ERROR INSERT** switch once. The switch LED flashes once indicating a single error is inserted.

Burst of Logic or BPV Errors — Inserted by having AUX ERR SEL function set to a specified duration, AUX ER RATE function set to a specified error rate, and pressing the **LOGIC** or **BPV ERROR INSERT** switch once. The **LOGIC** or **BPV** switch LED flashes twice indicating a burst of logic errors or BPVs are inserted at the specified duration and rate.

Consecutive Frame Errors — Inserted by having AUX FRM ERR function set to a specified number of consecutive frames errors and pressing the **FRAME ERROR INSERT** switch once. The **FRAME** switch LED flashes twice indicating consecutive frame errors are inserted.

Continuous Errors — Inserted by pressing the **ERROR INSERT** switches for more than two seconds. The switch LED flashes then illuminates continuously until the switch is pressed again. The continuous error rate is controlled by the AUX ER RATE function for BPVs and logic errors and the AUX FRM ERR function for frame errors. Pressing the illuminated **ERROR INSERT** switch again turns off the error insertion.

3.7 MAINFRAME — PRINTER CONTROL

The T-BERD 209A can generate a printout manually or automatically. The printouts provide a hard copy of the test results and the instrument configuration. The following switches (see Figure 3-7) and connector are used to generate the printouts.

- **PRINT** switch (23)
- **PRINT EVENT** switch (24)
- RS-232 connector

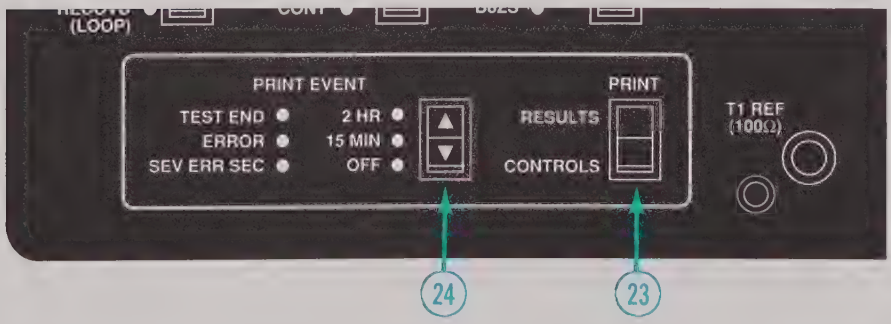


Figure 3-7
Printer Controls

When a results printout is initiated either manually or automatically, the test results are stored in the results history buffer and printer buffer. This allows the results to be reviewed from the AUX RES HIST function and stored in memory when a printer is not connected to the T-BERD 209A.

PRINT Switch (23)

This two-position switch initiates a test results and front-panel controls printout whenever either position is pressed.

RESULTS — Initiates a printout of the current test results.

CONTROLS — Initiates a printout of the current T-BERD 209A front-panel switch and auxiliary function settings.

PRINT EVENT Switch (24)

This six-position switch determines the events that automatically initiate a results printout.

OFF — No status or alarm messages are printed; all other positions enable the printing of status and alarm messages. Only manual prints can be initiated using the **PRINT** switch.

TEST END — If the T-BERD 209A is set for a timed test (see **TEST** switch), the results are printed when the test interval has expired. The test interval is controlled through the AUX TEST LEN function.

ERROR — Results are printed when any of the following events occur: logic errors, CRC errors, frame errors, BPVs, or changes in alarm conditions.

SEV ERR SEC — Results are printed when the bit error rate exceeds 10^{-3}. This selection is only available when the G.821 Performance Analysis Option is installed.

2 HR — Results are printed every 2 hours.

15 MIN — Results are printed every 15 minutes.

The AUX PRNT FMT function determines how the results printouts are formatted (NORMAL, SUMMARY, and SHORT). Refer to Section 5 for additional information.

RS-232 Connector

The female 25-pin D connector serves as the RS-232 printer or remote control interface connector. It is configured with DCE pin-outs to connect the T-BERD 209A to a printer. The connector interface is configured with the following auxiliary functions (see Section 5):

AUX BAUD — Sets the interface baud rate (300 bps, 1200 bps, 2400 bps, and 4800 bps).

AUX PARITY — Sets the interface parity (ODD, EVEN, or NONE).

AUX TERM — Sets the interface line terminator characters (CR or CRLF).

G.821 OPTION

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3.8 G.821 OPTION — INTRODUCTION

The G.821 Performance Analysis Option (209A-1) enables the T-BERD 209A to evaluate the long-term performance of your system. The option adds seven performance analysis results to the LOGIC category that are defined in the CCITT Recommendation G.821. The option also enables the **PRINT EVENT** switch SEV ERR SEC print event.

NOTE: Unless indicated, the capabilities of the mainframe are applicable to the G.821 Performance Analysis Option.

3.9 G.821 OPTION — FUNCTIONAL DESCRIPTION

Available and Unavailable Time

CCITT Recommendation G.821 defines available and unavailable time as follows:

> *A period of unavailable time begins when the bit error rate (BER) in each second is worse than 10^{-3} for a period of 10 consecutive seconds. These 10 seconds are considered to be unavailable time. The period of unavailable time terminates when the BER in each second is better than 10^{-3} for a period of 10 consecutive seconds. These 10 seconds are considered to be available time.*

Available and unavailable time are measured in seconds — available seconds and unavailable seconds (14-UNAVL SEC), respectively. All test seconds must fall into one of the two categories (total available seconds + total unavailable seconds = total test seconds).

At the beginning of a test, test seconds are considered to be available time; the available seconds begin counting. These seconds continue to be counted until 10 consecutive seconds occur each with a BER worse than 10^{-3}. A sliding window, 10 seconds in length, is used to detect this transition from available to unavailable time and vice versa.

As an example, assume a test begins and continues to run for 25 seconds and each of those 25 seconds has a BER better than 10^{-3}. When the test starts, test seconds are considered to be available time, so the available seconds count at this point is 25. In the 26th second, the BER becomes worse than 10^{-3}. The same for the 27th and 28th seconds. In the 29th second, the BER drops back to better than 10^{-3}. All 29 seconds are a part of available time and are, therefore, counted as available seconds.

sec 20 BER <=	sec 21 BER <=	sec 22 BER <=	sec 23 BER <=	sec 24 BER <=	sec 25 BER <=	sec 26 BER >	sec 27 BER >	sec 28 BER >	sec 29 BER <=

Sliding Window After 29th Test Second
Still in Available Time

Even though there were 3 consecutive seconds (the 26th, 27th, and 28th) which each had a BER worse than 10^{-3}, 10 such consecutive seconds are required to make the transition to unavailable time. Those 3 individual seconds are still in available time and they are counted as available seconds.

The three seconds with a BER worse than 10^{-3} are also included in the count of severely errored seconds (10-SEV ERR SEC), which are those test seconds with a BER worse than 10^{-3} that occur in available time. A signal loss second (60-SIG LOS SEC) or a second in which pattern synchronization is lost is also considered to be a second with a BER worse than 10^{-3}. Therefore, the current test result values for available seconds count = 29; the 10-SEV ERR SEC count = 3, and the 14-UNAVL SEC count = 0.

The same test continues to run and remains in available time. In the 80th second, the BER for that second is worse than 10^{-3}. The BER for the 81st, 82nd, 83rd, 84th, and 85th seconds is also worse than 10^{-3}. In the 86th second, pattern synchronization is lost. This also continues for the 87th and 88th seconds. We now have 9 consecutive seconds each of which has a BER worse than 10^{-3}. As each of these test seconds occurs, we are still in available time, so they are counted as available seconds and 10-SEV ERR SEC. The transition has not been made from available time to unavailable time.

sec 79 BER <=	sec 80 BER >	sec 81 BER >	sec 82 BER >	sec 83 BER >	sec 84 BER >	sec 85 BER >	sec 86 BER >	sec 87 BER >	sec 88 BER >

Sliding Window After 88th Test Second
Still in Available Time

The 89th test second also has a BER worse than 10^{-3}. At this point, the available seconds count = 89, the 10-SEV ERR SEC count = 13, and the 14-UNAVL SEC count = 0. However, the sliding window now contains 10 consecutive seconds each of which has a BER worse than 10^{-3}. A transition is made to unavailable time.

sec 80 BER >	sec 81 BER >	sec 82 BER >	sec 83 BER >	sec 84 BER >	sec 85 BER >	sec 86 BER >	sec 87 BER >	sec 88 BER >	sec 89 BER >

Sliding Window After 89th Test Second Transition to Unavailable Time

Those 10 seconds which had been counted as available seconds are deducted from the available seconds count and are added to the 14-UNAVL SEC count; the available seconds count becomes 79, and the 14-UNAVL SEC count becomes 10. Those same 10 seconds were also included in the 10-SEV ERR SEC count. However, 10-SEV ERR SEC is limited to only those seconds in available time which have a BER worse than 10^{-3}; therefore, those last consecutive 10 seconds must also be deducted from the 10-SEV ERR SEC count (the 10-SEV ERR SEC count is updated to 3).

Once the transition occurs from available time to unavailable time, all test seconds are counted as 14-UNAVL SEC until 10 consecutive seconds occur each with a BER better than 10^{-3}. As the sample test continues, the 90th through 150th seconds each have a BER worse than 10^{-3}. We are still in unavailable time, so these seconds are counted as 14-UNAVL SEC; now the total available seconds count = 79 and the total 14-UNAVL SEC count = 71.

Beginning with the 151st second, the BER for that second falls below 10^{-3}. It is still counted as an unavailable second since we are still in unavailable time and the transition has not been made to available time. A BER better than 10^{-3} also occurs for the 152nd, 153rd, 154th, 155th, 156th, 157th, 158th, 159th, and 160th seconds. Since there are now 10 consecutive seconds with a BER less than 10^{-3}, the transition is made from unavailable time to available time.

sec 151 BER <	sec 152 BER <	sec 153 BER <	sec 154 BER <	sec 155 BER <	sec 156 BER <	sec 157 BER <	sec 158 BER <	sec 159 BER <	sec 160 BER <

Sliding Window After 160th Test Second Transition to Available Time

As each of these faulty 10-second intervals occurred, it was added to the 14-UNAVL SEC count (14-UNAVL SEC = 81, available seconds = 79, and 10-SEV ERR SEC = 3). Now that

the last group of seconds has triggered the transition to available time, that group of seconds is deducted from the 14-UNAVL SEC count and added to the available seconds count. Now the 14-UNAVL SEC count = 71 and the available seconds count = 89.

The monitoring of available and unavailable time continues for the duration of the test.

Degraded Minutes

Degraded minutes (12-DEGR MIN) is an error analysis result that is affected by available and unavailable time. 12-DEGR MIN is a count of the number of minutes during which an average BER worse than 10^{-6}, but better than 10^{-3}, occurs. The 1-minute intervals are derived by removing 14-UNAVL SEC and 10-SEV ERR SEC from the total test time and then consecutively grouping the remaining seconds into blocks of 60. The average BER is calculated for the block of 60 seconds and, if it is worse than 10^{-6}, the block is counted as a degraded minute.

In the transition from available time to unavailable time, the 12-DEGR MIN result is unaffected. This is because a switch to unavailable time requires 10 consecutive seconds each with a BER worse than 10^{-3}. Any second in available time with a BER worse than 10^{-3} is considered to be a severely errored second and, therefore, not included in the accumulation of seconds used to calculate degraded minutes.

Moving from unavailable time to available time may affect the 12-DEGR MIN count. While in unavailable time, 10 consecutive seconds each with a BER better than 10^{-3} are required for the transition to available time. When this happens, those 10 seconds are subtracted from the 14-UNAVL SEC count and are added to the available seconds count. Since these seconds are now considered to be a part of available time and they are not severely errored seconds, they are included in the calculation of degraded minutes.

3.10 G.821 OPTION — TEST SETUP

Auxiliary Functions

In addition to the standard mainframe auxiliary functions, the following auxiliary functions are affected by or have an affect on the G.821 Option functions (see Section 5).

AUX HALT/CONT — When pattern synchronization is lost, the bit error count continues or halts based on the AUX HALT/CONT function setting.

3.11 G.821 OPTION — STARTING TEST/COLLECTING RESULTS

Collecting Test Results

In addition to the standard mainframe LOGIC category results, the following G.821 test results are added to the LOGIC category (see Section 6).

10 - SEV ERR SEC	Severely Errored Seconds
11 - %SEV ER SEC	% Severely Errored Seconds
12 - DEGR MIN	Degraded Minutes
13 - %DEGR MIN	% Degraded Minutes
14 - UNAVL SEC	Unavailable Seconds
15 - %AVLBILITY	% Availability
16 - CSES	Consecutive Severely Errored Seconds

3.12 G.821 OPTION — PRINTER CONTROL

PRINT EVENT Switch

The **PRINT EVENT** switch SEV ERR SEC function is activated when this option is installed. This enables a results printout to be generated when the bit error rate exceeds 10^{-3}.

ADVANCED BERT OPTION

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ADVANCED BERT OPTION

3.13 ADVANCED BERT OPTION — INTRODUCTION

The Advanced Bit Error Rate Test (BERT) Option (209A-3) adds seven T1 stress patterns and a programmable long user pattern to the T-BERD 209A. The seven minimum/maximum density stress patterns are designed to stress test timing recovery circuits and span-line repeater ALBO circuitry. The programmable long user pattern enables patterns of up to 2000 hexadecimal bytes to be programmed into memory.

NOTE: Unless indicated, the capabilities of the mainframe are applicable to the Advanced BERT Option.

3.14 ADVANCED BERT OPTION — TEST SETUP

Auxiliary Functions

In addition to the standard mainframe auxiliary functions, the following auxiliary function is added to the T-BERD 209A (see Section 5):

AUX LUP — Long User Pattern auxiliary function is used to program LUP into the T-BERD 209A in a hexadecimal format.

PATTERN Switch

In addition to the standard mainframe test patterns, the Advanced BERT Option adds the following test patterns. Unless otherwise indicated, these patterns can be transmitted framed or unframed.

T1 DALY — This pattern is identical to the 55 OCTET pattern, except that the seventh octet is 80H instead of 00H. This change enables the pattern to meet ones density and excess zeros criteria. See Appendix C for the bit and hexadecimal pattern.

T1-2/96 — This is a 96-octet pattern that can be used to detect faulty M12 cards in DS3 equipment. The pattern consists of long series of high ones density octets followed by quick changes from average ones density to low ones density octets. When the pattern is

frame aligned, it provides a maximum of 15 zeros and meets the ones density criteria. This pattern causes false frame synchronization on D4-type framed circuits. See Appendix C for the bit and hexadecimal patterns.

T1-3/54 — This is a 54-octet pattern that can be used to stress test repeater pre-amplification, equalization, and automatic line build-out (ALBO) circuitry. The pattern consists of rapid transitions from low ones density octets to high ones density octets. When the pattern is frame aligned, it exceeds the maximum zeros criteria and should only be transmitted over the repeatered span and not the network. See Appendix C for the bit and hexadecimal patterns.

T1-4/120 — This is a 120-octet pattern that can be used to stress test equalization circuits between T1 multiplexers. The pattern is similar to the T1-2/96 pattern and consists of rapid changes from high ones density to minimum ones density octets. When the pattern is frame aligned, it contains a maximum of seven zeros criteria and meets the ones density criteria. See Appendix C for the bit and hexadecimal pattern.

T1-5/53 — This is a 53-octet pattern that can be used to stress test repeater equalization and ALBO circuitry. The pattern consists of rapid transitions from high ones density octets to low ones density octets. When the pattern is frame aligned, it does not exceed the maximum zeros criteria but it does exceed the 8(n+1) ones density criteria. The pattern should only be transmitted over the repeatered span and not the network. See Appendix C for the bit and hexadecimal patterns.

55 OCTET — This is a 55-octet pattern that can be used to stress test repeater timing recovery and ALBO circuitry. The pattern consists of rapid transitions from high ones density octets to low ones density octets. When the pattern is frame aligned, it violates the maximum zeros and ones density criteria. The pattern should only be transmitted over the repeatered span and not the network. See Appendix C for the bit and hexadecimal patterns.

MIN/MAX — This is a 72-octet minimum/maximum density pattern that can be used to stress test repeater pre-amplification, equalization, and ALBO circuitry. The pattern generates rapid transitions from low ones density octets to high ones density octets. When the pattern is frame aligned, it meets the maximum zeros and ones density criteria. See Appendix C for the bit and hexadecimal patterns.

LUP — Long User Pattern provides the ability to transmit a 1- to 2000-hexadecimal user programmable test pattern. This allows the T-BERD 209A to transmit specific character patterns to test circuit sensitivity to a particular pattern. The pattern is entered in hexadecimal form through the AUX LUP function. The pattern is transmitted starting from the LSB to the MSB of each hexadecimal character.

Example: 74H = (MSB) 0111 0100 (LSB); transmitted in the following order: (LSB) 0010 1110 (MSB). The LUP pattern is frame aligned when transmitted in the framed T1 modes.

ENHANCED ESF OPTION

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ENHANCED ESF OPTION

3.15 ENHANCED ESF OPTION — INTRODUCTION

The Enhanced ESF Option (209A-4) provides the comprehensive and advanced test capabilities required for installing and maintaining ANSI T1.403 ESF circuits. This option provides monitor and emulation capabilities of the one-second broadcast or Performance Report Message (PRM), per the ANSI T1.403 specification. In addition, the option adds compatibility with the ZBTSI (Zero Byte Time Slot Interchange) clear channel format.

NOTE: Unless indicated, the capabilities of the mainframe are applicable to the Enhanced ESF Option.

3.16 ENHANCED ESF OPTION — TEST SETUP

MODE Switch

In addition to the standard mainframe operating modes, the following mode is added to the switch selections.

T1 ESFz — T1 ZBTSI Encoded Extended Superframe mode configures the T-BERD 209A to transmit and receive ZBTSI (Zero Byte Time Slot Interchange) encoded ESF framed T1 data to test ZBTSI encoded circuits.

Auxiliary Functions

The following auxiliary functions control the setup and operation of the Enhanced ESF Option (see Section 5).

AUX RESPONSE — The T-BERD 209A *does* respond to ESF out-of-band loop codes when the T-BERD 209A is configured for T1 ESFz or FT1 ESFz operation.

AUX ESF LOOP — For loopback testing, this function provides in-band and ESF out-of-band loop code transmission capabilities in the T1 ESFz mode.

AUX FRM ERR — Frame errors can be inserted on the F-bit or Z-bit through the AUX FRM ERR, T1 ESFz, function.

AUX LP CODE — When the ESFz mode is selected, the in-band and ESF out-of-band loop code types are selected from the AUX ESF LOOP function.

AUX PRM — The Performance Report Message Control auxiliary function determines how the PRM is transmitted and whether the PRM results are accumulated. The auxiliary function is only active in the ESF and ESFz operating modes.

CODE Switch

When the T1 ESFz mode is selected, the **CODE** switch is disabled.

3.17 ENHANCED ESF OPTION — STARTING TEST/COLLECTING RESULTS

Collecting Test Results

The ESF datalink far-end PRM results enable the T-BERD 209A to monitor and report on the status of the ESF datalink PRM as described in the ANSI T1.403-1989 standard. The far-end PRM results appear in the BPV & FRAME and SUMMARY (results 17 to 21 and 22-FAR CRC ERR) categories and include (see Section 6):

17-FAR FRM ES	Far-End Frame Error Seconds
18-FAR FRM SES	Far-End Severely Errored Framing Seconds
19-FAR BPV SEC	Far-End BPV Seconds
20-FAR SLP SEC	Far-End Controlled Slip Seconds
21-FAR PRM SEC	Far-End Performance Report Seconds
22-FAR CRC ERR	Far-End CRC Error Events
22-FCRC 1	Far-End CRC 1 Bin
22-FCRC 2-5	Far-End CRC 2 to 5 Bin
22-FCRC 6-10	Far-End CRC 6 to 10 Bin
22-FCRC11-100	Far-End CRC 11 to 100 Bin
22-FCRC101-319	Far-End CRC 101 to 319 Bin
22-FCRC>319	Far-End CRC 320 to 333 Bin
23-PAY SRC	Far-End Payload Source/Loopback

The far-end PRM results are available when either the ESF or ESFz operating mode is selected and the AUX PRM function is enabled. The far-end PRM results are also available in the AUTO LLB and T1 TLB modes.

3.18 ENHANCED ESF OPTION — TROUBLESHOOTING CONTROLS

ERROR INSERT Switches

When ZBTSI encoded data is received, the **FRAME ERROR INSERT** switch is disabled in the T1 TLB, T1 LLB, and AUTO LLB modes.

TDR OPTION

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3.19 TDR OPTION — INTRODUCTION

The TDR Option (209A-5) configures the T-BERD 209A to operate as a Time Domain Reflectometer. The TDR tests and locates line impairments such as shorts, opens, splices, coils, and bridge taps on twisted-pair copper wire with minimal setup. Faults and distances appear in plain English on the front panel. Test results, TDR setup, and fault location trace can be printed in graphic form using the TTC PR-40A Thermal Printer.

NOTE: Unless indicated, the capabilities of the mainframe are applicable to the TDR Option.

3.20 TDR OPTION — FUNCTIONAL DESCRIPTION

The TDR mode enables the T-BERD 209A to test a cable pair for faults and indicates the fault in plain English (i.e., short, open, etc.) and the distance to the fault on the front-panel display. The cable type (dielectric and wire gauge) or propagation velocity (PR. VEL), and approximate distance being tested are the only parameters necessary to test a cable pair with the T-BERD 209A.

Selecting the cable type and wire gauge configures the TDR to compensate for wire resistivity and dielectric characteristics that affect signal transmission. The wire gauge determines the resistive characteristics of the wire; the smaller the wire size (higher the wire gauge), the higher the resistivity. The dielectric characteristics determine the speed of the signal through the wire which is known as the propagation velocity.

Selecting the distance being measured determines how far the TDR can provide fault recognition results about the cable pair. The closer the fault is to the source, the narrower the pulse that is sent. The TDR can be set to distances of 1000, 3000, and 6500 feet. If the distance is not known, the TDR can be set in an auto mode which automatically tests the cable pair to the first fault.

When the TDR mode is activated, pulses are sent down the cable pair. Between each pulse the TDR monitors the span for reflections caused by a change in impedance on the cable pair. This change in impedance can be caused by splice connections, bridge taps, coils, shorts, or opens, to name just a few. The TDR measures the time taken for the reflection to return to the TDR and calculates the distance from the TDR to the suspected fault.

At the same time, the TDR also analyzes the reflected signal. The reflection becomes a signature for the different faults found on the cable pair. Figure 3-8 shows several typical reflections. Once the reflection signature is identified, the TDR can display the fault and the distance to each fault in the RESULTS I window; there is no need to interpret a waveform of a TDR trace on a TDR oscilloscope. Up to four faults can be detected and reported in the display during one test.

If a hard short or open is detected across the pair, all of the transmitted energy is reflected back and no other faults can be detected beyond the short or open. The displayed results would only show one fault. However, if a partial short or open occurs on either side of the cable pair, the transmitted energy can travel further down the cable pair and detect other faults. Further sectionalization and testing of the span is required beyond the short or open. If the TDR detects a fault but does not recognize it, the TDR identifies the fault as unrecognized. Further analysis of the unrecognized fault can be accomplished by removing previous faults, printing the TDR graph again, and comparing it to known fault traces like those shown in Figure 3-8.

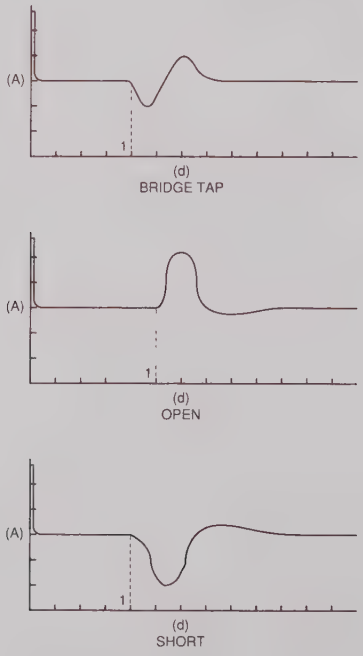


Figure 3-8
Typical TDR Traces

3.21 TDR OPTION — TEST SETUP

Front Panel Display

The display is the only indicator used in the TDR mode; all others are disabled. There are three basic displays that appear in the TDR mode: setup, results, and testing.

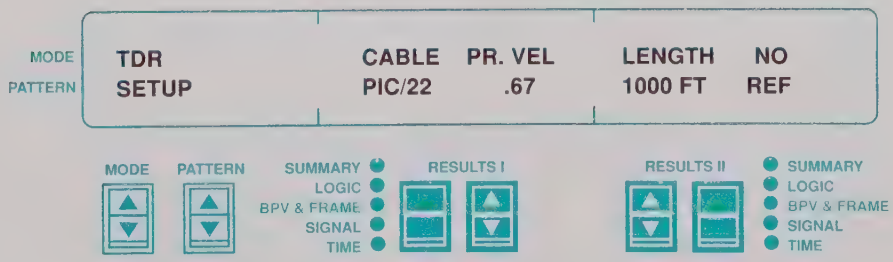
MODE Switch

Pressing the **MODE** switch until TDR appears in the MODE window selects the TDR mode. When TDR is selected, either the SETUP menu or the previous test results appear in the display. However, at power-up the TDR SETUP menu is the default display. The T-Carrier modes are disabled when TDR is selected. However, the last T-Carrier mode selected and configured remains in memory.

PATTERN Switch

Pressing the **PATTERN** switch selects either the TDR SETUP menu or the TDR RESULTS. The TDR SETUP menu is used to select the cable type, propagation velocity (PR. VEL), cable length, and store a reference trace for a printout. The TDR RESULTS indicates up to four faults and their distances from the T-BERD 209A.

When the TDR mode SETUP menu is selected, the following display appears:



RESULTS Switches

The **RESULTS** switches perform the following functions in the TDR SETUP menu:

RESULTS I Category Switch — Press this switch to select the desired CABLE type, associated wire gauge, and PR. VEL displayed in the RESULTS I window. Table 3-4 lists three commonly used cable types and three twisted-pair copper wire gauges that are available from the front panel.

The **RESULTS I Category** switch is disabled during testing and after the TDR RESULTS appear.

It is very important to match the TDR CABLE type setting with the type of cable being tested. If the TDR CABLE type selection and cable being tested are not matched, inaccurate distances can occur and faults can be misinterpreted. The USER selection allows the wire gauge and PR. VEL of an unlisted cable type to be selected (see **RESULTS I Results** switch).

Table 3-4
Selectable Cable Types

CABLE	PROP VEL	Description
PIC/22 PIC/24 PIC/26	.67 .66 .65	22 to 26 gauge PIC (polyethylene insulated cable) wire.
JELL/22 JELL/24 JELL/26	.62 .61 .60	22 to 26 gauge jelly-filled insulated wire.
PULP/22 PULP/24 PULP/26	.71 .70 .68	22 to 26 gauge paper-pulp insulated wire.
USER/22 USER/24 USER/26	.40 - .99	When the wire gauge and PR. VEL are known for a cable not listed, select the wire gauge with the **RESULTS I Category** switch and PR. VEL with the **RESULTS I Results** switch in 0.01 steps.
DEFAULT	.66	If the PR. VEL and CABLE type are unknown, select DEFAULT to set the PR. VEL at 0.66.

RESULTS I Results Switch — When USER appears under CABLE (selected with the **RESULTS I Category** switch), press this switch to select the desired PR. VEL from 0.40 to 0.99 in 0.01 steps. This is helpful when the cable type is not listed under CABLE. This switch is disabled during testing and when the other CABLE selections are displayed.

RESULTS II Results Switch — Press this switch to select one of the following LENGTH selections: 1000, 3000, and 6500 feet or AUTO mode. The LENGTH selections determine how far out the TDR tests the cable pair.

The AUTO mode automatically tests the cable pair out to the first fault. The selected length also affects the distance scale printed on the TDR GRAPH. This switch is disabled during testing.

Changing the LENGTH when REF STORED is displayed in the TDR SETUP menu erases the reference trace and any results that are in memory. NO REF also replaces REF STORED in the display.

RESULTS II Category Switch — Press this switch to toggle between NO REF and REF STORED which indicates the current status of the reference trace print buffer and how the TDR GRAPH is printed.

NO REF indicates that the buffer is empty. With NO REF displayed, pressing this switch saves the current test result in memory as the reference trace and REF STORED appears.

REF STORED indicates that the buffer has a stored reference trace. With REF STORED displayed, pressing this switch erases the reference trace from memory and NO REF appears. Refer to Section 3.24 to print a TDR graph. The switch is disabled during testing.

3.22 TDR OPTION — CIRCUIT CONNECTIONS

When the TDR mode is selected, the T1 REF (TDR) jacks become the TDR connection (only one jack can be used at one time) for the T-BERD 209A. The T1 REF (TDR) jack is terminated so that the TDR can be connected directly to the twisted-pair copper wire. The TDR only tests one cable pair at a time.

NOTE: The T-BERD 209A T1 connections (TRANSMIT and RECEIVE jacks) must be disconnected before testing the line with the TDR to prevent unwanted reflections.

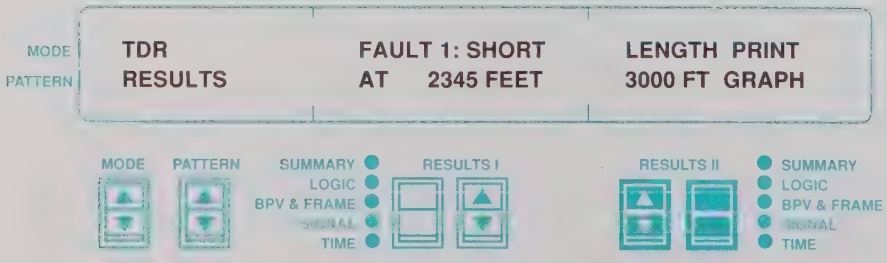
WARNING: To test T1 spans, remove simplex current before connecting the T1 REF (TDR) jack to the cable pair to prevent electrical shock.

3.23 TDR OPTION — STARTING TEST/COLLECTING RESULTS

Once the TDR SETUP menu is configured, pressing the **RESTART** switch activates the TDR. The testing display flashes the messages *TESTING* in the PATTERN window and *RESULTS NOT AVAILABLE* in the RESULTS I window. The front-panel switches (except the **MODE** switch) are disabled until the test is complete.

A typical TDR test takes approximately 12 seconds to perform but can range from 5 to 20 seconds depending on the cable length and the number of faults found. Once the test is complete, the TDR RESULTS appear.

Once the TDR test signal has reached the selected test length, the first fault, or the maximum test length in AUTO mode, the TDR RESULTS display appears indicating whether faults were detected.



RESULTS Switches

The **RESULTS** switches perform the following functions in the TDR RESULTS display:

RESULTS I Category Switch — This switch is disabled when the TDR RESULTS appear.

RESULTS I Results Switch — Press this switch repeatedly to scroll through the reported faults that appear in the RESULTS I window. Press the up arrow to scroll the faults from Fault 1 to the last detected fault and press the down arrow to scroll the faults from the last detected fault to Fault 1. Up to four faults can be detected and reported in the display during one test. The following messages and faults can appear in the TDR RESULTS display:

NONE — No faults were detected within the selected cable length, only if the selected cable length is less than the actual length of the cable pair being tested. A terminated cable pair with no faults between the termination and T-BERD 209A is also indicated as NONE.

OPEN at nnnn FT — An open in the cable pair is detected at nnnn feet. If the distance to the open is less than the known cable length, the open must be repaired and the cable pair retested. If the distance to the open is equal to the known cable pair length, then the cable pair is good.

SHORT at nnnn FT — A short in the cable pair is detected at nnnn feet. If the distance to the short is less than the known length of the cable pair, then the short must be repaired and the cable pair retested. If the end of the cable pair is shorted and the displayed distance is equal to the cable length, then the cable pair is good.

B-TAP at nnnn FT — A bridge tap is detected at nnnn feet. The bridge tap should be removed and the pair retested.

UNREC at nnnn FT — An unrecognized fault in the cable pair is detected at nnnn feet. Further investigation is required. Printing a TDR GRAPH may provide an indication of the fault.

RESULTS II Results Switch — This switch performs the same function as previously described. The LENGTH can be changed between each test without having to return to the TDR SETUP menu. However, changing the LENGTH when a reference trace is stored in memory erases the trace; the PRINT GRAPH function cannot print a graph with two different lengths.

RESULTS II Category Switch — Press this switch, when labeled PRINT GRAPH, to print a TDR trace and distance graph on a graphics compatible printer.

3.24 TDR OPTION — PRINTER CONTROL

Three possible printouts are generated in the TDR mode: controls printout, results printout, and a graph printout. All printouts are date- and time-stamped.

Printing TDR Setup Controls and Results

Press the **PRINT** switch CONTROLS position to generate a TDR SETUP controls printout. The printout lists the current TDR SETUP menu configuration.

Press the **PRINT** switch RESULTS position to generate a TDR results printout. The printout lists the current faults detected and the distance to the fault as they appear in the TDR RESULTS display.

Printing TDR GRAPHs

The TDR graph printout is initiated by pressing the **RESULTS II Category** switch when the TDR mode RESULTS and PRINT GRAPH appear. Figure 3-9 shows a sample TDR graph printout. Refer to Section 7 for information on printing single, dual, and magnified TDR graphs.

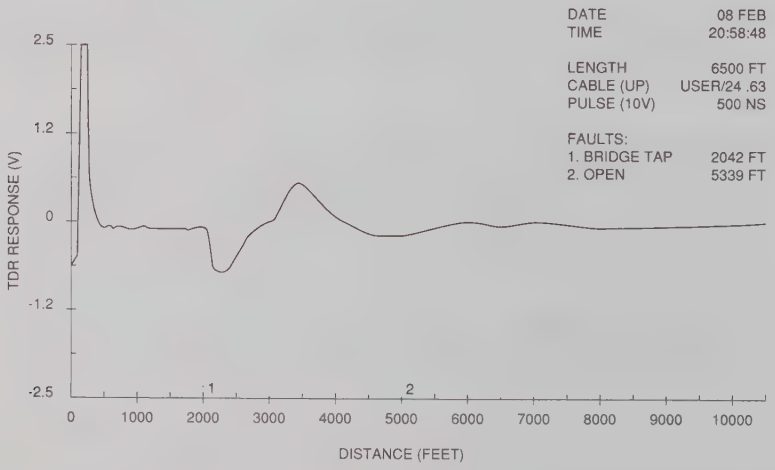


Figure 3-9
TDR Graph Printout

FRACTIONAL T1 OPTION

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TROUBLESHOOTING CONTROLS

FRACTIONAL T1 OPTION

3.25 FT1 OPTION — INTRODUCTION

The Fractional T1 (FT1) Option (209A-6) provides fractional T1 modes for contiguous and noncontiguous, 56xN and 64xN, FT1 testing capabilities in D4, ESF, and ESFz framing formats.

NOTE: Unless indicated, the capabilities of the mainframe are applicable to the FT1 Option.

3.26 FT1 OPTION — TEST SETUP

MODE Switch

In addition to the mainframe operating modes, the following FT1 operating modes are also available:

FT1 D4 — D4 Superframe Fractional T1 mode configures the T-BERD 209A to transmit and receive D4 framed FT1 data. The FT1 D4 mode is compatible with D3 and D4 superframe formats.

FT1 ESF — Extended Superframe Fractional T1 mode configures the T-BERD 209A to transmit and receive ESF framed FT1 data.

FT1 ESFz — ZBTSI Encoded ESF Fractional T1 mode configures the T-BERD 209A to transmit and receive ZBTSI encoded ESF framed FT1 data. This operating mode requires the Fractional T1 Option and Enhanced ESF Option.

Auxiliary Functions

In addition to the standard mainframe auxiliary functions, the following auxiliary functions are added to the T-BERD 209A (see Section 5).

AUX FT1 CHAN — The Fractional T1 Channel Bandwidth auxiliary function selects the FT1 channel bandwidth being tested in FT1 circuits.

AUX FT1 SETUP — The FT1 Idle Code and Channel Rate auxiliary function sets the FT1 idle code and channel rate.

The following auxiliary functions are affected by or have an affect on the FT1 Option (see Section 5).

AUX RESPONSE — When operating in the FT1 modes and AUTO RESPONSE is enabled, the T-BERD 209A does not respond to in-band loop codes. However, the T-BERD 209A does respond to ESF out-of-band loop codes when configured for FT1 ESF or FT1 ESFz operation. The AUTO RESPONSE mode also establishes a full bandwidth loopback and bit error rate test.

AUX ERR SEL — To test FT1 circuits, a single error is only inserted in the selected FT1 bandwidth. However, the burst, consecutive, and continuous error insertion is applied to the entire T1 bandwidth.

AUX LP CODE — When the FT1 ESF or FT1 ESFz mode is selected, the in-band and ESF out-of-band loop code types are selected from the AUX ESF LOOP function.

AUX ESF LOOP — When FT1 modes are selected, the T-BERD 209A only sends in-band loop codes within the selected FT1 channel bandwidth. However, the T-BERD 209A does not respond to FT1 in-band loop codes.

AUX FRM ERR, T1 ESFz — When the FT1 ESFz mode is selected, the auxiliary function allows frame error insertion in either the ESFz F-bits or Z-bits.

PATTERN Switch

The BRIDGTAP and MULTIPAT patterns are not available in the FT1 modes. When configured in an FT1 mode, the LUP pattern is not frame aligned within the selected FT1 bandwidth.

3.27 FT1 OPTION — TROUBLESHOOTING CONTROLS

LOOP CODE Switches

When testing FT1 circuits, the T-BERD 209A only sends in-band loop codes within the selected FT1 channel bandwidth or in the ESF datalink. For loopback testing, the AUX ESF LOOP function provides in-band and ESF out-of-band loop code transmission capabilities in the FT1 ESF or FT1 ESFz mode.

ERROR INSERT Switches

To test FT1 circuits, a single error is only inserted in the selected FT1 bandwidth, and CRC errors are not calculated. The burst, consecutive, and continuous error insertion is applied to the entire T1 bandwidth.

SECTION 4
LID OPTIONS

T1 CHANNEL MONITOR OPTION

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T-BERD T1 CHANNEL MONITOR OPTION

4.1 T1 CHANNEL MONITOR — INTRODUCTION

This section describes the T-BERD T1 Channel Monitor Option which attaches to the T-BERD 209A to provide DS0 channel monitoring from a DS1 access point.

4.2 T1 CHANNEL MONITOR — FEATURES

The T-BERD T1 Channel Monitor provides the following features and characteristics:

Simultaneously displays all 24 signaling bits which allows a *quick* look at the hook switch and ringing status of a T1 channel or view the ongoing signaling of a T1 trunk.

LED bar graph displays the VF signal level from -54 dBm to +3 dBm in 3 dBm steps.

Drops and inserts the ESF datalink which permits monitoring or testing of the ESF datalink from an external test set.

Drops the SLC-96 datalink which permits monitoring of the SLC-96 datalink from an external test set.

VF output provides access to an external VF test set via 600 ohm VF output jack.

ISDN compatibility can be achieved by dropping any of the 24, 64 kb/s, channels.

4.3 T1 CHANNEL MONITOR — CONNECTION TO T-BERD 209A

The T-BERD T1 Channel Monitor attaches to the T-BERD 209A by connecting the coiled cable from the T-BERD T1 Channel Monitor to the T-BERD 209A 15-pin D connector (see Figure 4-1). The cable provides power and the T1 signal to the T-BERD T1 Channel Monitor.

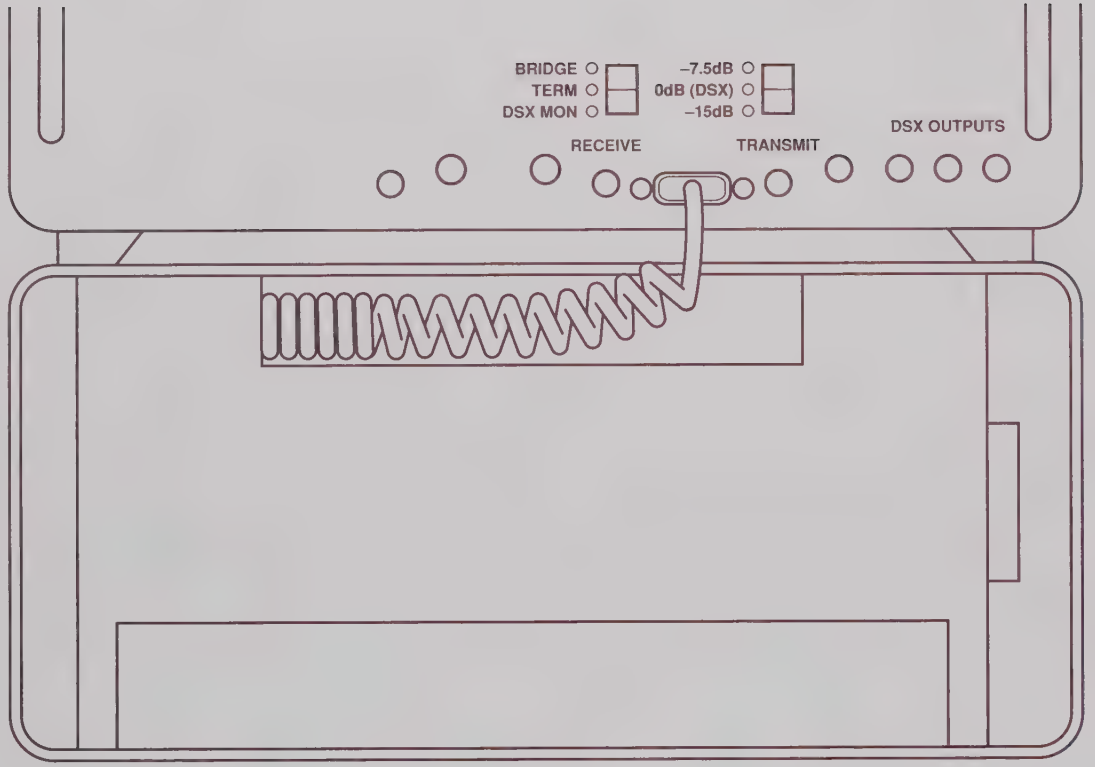

Figure 4-1
Connecting the T-BERD T1 Channel Monitor to the T-BERD 209A

4.4 T1 CHANNEL MONITOR — TEST SETUP

Figure 4-2 shows the T-BERD T1 Channel Monitor. The controls, indicators, and connections are listed in the order that you might use them to drop and monitor the channel signaling, VF signal and level, data bits, ESF or SLC datalink, and DS0 channel.

FRAME FORMAT Switch (1)

This multiposition switch enables synchronization to the framing format of the T1 circuit under test. The LEDs show the current setting of the switch. The switch selects one of five framing formats: ESF, SLC, D3/D4, D2, and D1D. The framing format must match the format set on the T-BERD 209A. Note that D3/D4 framing is the default setting at power-up.

Frame Sync Loss LED

This LED illuminates when the T-BERD 209A is not synchronized to the received framing format.

CHANNEL SELECT Switch (2)

This rocker switch selects the DS0 channel to be monitored on the T1 circuit. Channel 24 is always the first channel displayed at power-up. The channel number is displayed in a two-digit readout located next to the switch.

SIGNALING Display (3)

This display is a 4 x 24 LED array that shows the channel signaling status for each of the 24 voice channels in the T1 signal. When the ESF framing format is selected, the entire LED array (rows A-D) is multiplexed and updated at the ESF signaling rate (333 times per second). In all the other framing formats, only the LEDs in rows A and B are updated. Table 4-1 identifies the channel timeslot assignments for the T1 framing formats offered by the T-BERD T1 Channel Monitor.

NOTE: The SIGNALING display is blank during the absence or loss of frame synchronization.

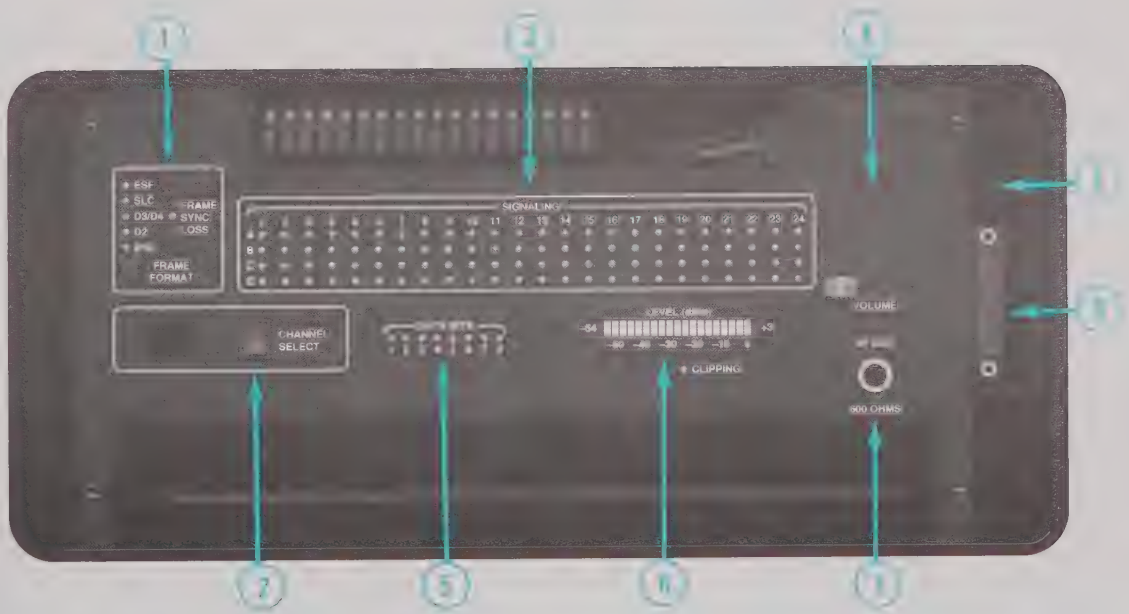

Figure 4-2
T-BERD T1 Channel Monitor Front Panel

Table 4-1
Channel Timeslot Assignments

T1 Timeslot	D1D Channel Number	D2 Channel Number	D3/D4/ESF Channel Number	SLC Channel Number
1	1	12	1	1
2	13	13	2	13
3	2	1	3	2
4	14	17	4	14
5	3	5	5	3
6	15	21	6	15
7	4	9	7	4
8	16	15	8	16
9	5	3	9	5
10	17	19	10	17
11	6	7	11	6
12	18	23	12	18
13	7	11	13	7
14	19	14	14	19
15	8	2	15	8
16	20	18	16	20
17	9	6	17	9
18	21	22	18	21
19	10	10	19	10
20	22	16	20	22
21	11	4	21	11
22	23	20	22	23
23	12	8	23	12
24	24	24	24	24

Speaker and VOLUME Control (4)

The built-in speaker allows the user to hear the audio output of the voice frequency signal once a channel is decoded. The **VOLUME** switch located below the speaker controls the volume level.

Data Bit LEDs (5)

The eight LEDs indicate the status of the individual data bits for the selected channel.

NOTE: The Data Bit LEDs are blank during the absence or loss of frame synchronization.

LEVEL (dBm) Display (6)

The bar graph displays the average level of the currently selected VF channel. Consisting of 20 segments with a 3 dB change in amplitude per segment, the bar graph features a thermometer-style presentation; the more segments that are illuminated, the greater the amplitude.

Clipping LED

This LED illuminates when either the maximum positive or negative digital VF signal is received (while the +3 dB bar graph segment is illuminated). When the Clipping LED flashes during normal conversation, it signals that the gain at the source may be too high.

VF OUT 600 OHM Jack (7)

This 600-ohm output jack allows the currently selected VF channel to be output to an external VF test set for in-depth analysis.

DATALINK/CHANNEL Switch (8)

This switch controls the output of the RS-232 connector. It enables either the 4 kb/s ESF datalink, SLC-96 datalink, or DS0 channel data to be output through the connector as follows:

- To output the SLC-96 datalink, set the **FRAMING** switch to SLC and the **DATALINK/CHANNEL** switch to DATALINK.
- To output the ESF datalink, set the **FRAMING** switch to ESF and the **DATALINK/CHANNEL** switch to DATALINK.
- To output the selected DS0 channel, set the **FRAMING** switch to the desired framing format (ESF, SLC, D3/D4, D2, or D1D) and the **DATALINK/CHANNEL** switch to CHANNEL.

In ESF framing format, data can be inserted on the datalink no matter what the **DATALINK/CHANNEL** switch is set to, or which channel is selected.

RS-232 Connector (9)

The RS-232 25-pin D connector enables terminal equipment (e.g., protocol analyzer) to be connected to the T-BERD T1 Channel Monitor to provide access to either the datalink or DS0 channel for further analysis. The signal is selected by the **DATALINK/CHANNEL** switch.

The RS-232 connector is configured as a DCE and transmits data synchronously. A transmit clock is supplied with the transmit data, and a receive clock synchronizes the receive data to be inserted into the datalink. Refer to Section 9 for a description of the connector pin assignments.

REPEATER POWER SUPPLY OPTION

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SAFETY

CONNECTION TO T-BERD 209A

T1 SPAN TESTING

AC POWER CONNECTION

CURRENT SETTING

APPLYING POWER

REPEATER POWER SUPPLY OPTION

4.5 REPEATER POWER SUPPLY — INTRODUCTION

This section describes the T-BERD Repeater Power Supply Option (see Figure 4-3) which attaches to the T-BERD 209A to provide power to a T1 span and access to the T1 circuit for testing.

4.6 REPEATER POWER SUPPLY — FEATURES

The T-BERD Repeater Power Supply Option offers the following features and capabilities:

Provides power to a repeatered T1 span line.

Provides a T1 signal interface for the T-BERD 209A.

Measures the voltage across the circuit to determine whether the applied voltage correlates with the expected voltage dictated by the circuit design.

Measures span current to verify proper powering of span repeaters.

Enables testing and verification of newly-installed T-Carrier circuits before span power is applied at the central office.

Sectionalize and isolate T1 span line faults with a single technician by using the Loopback Connector which provides a hard loop of a received T1 test pattern.

Housed in the T-BERD 209A cover.

Complies with IEEE STD-743.

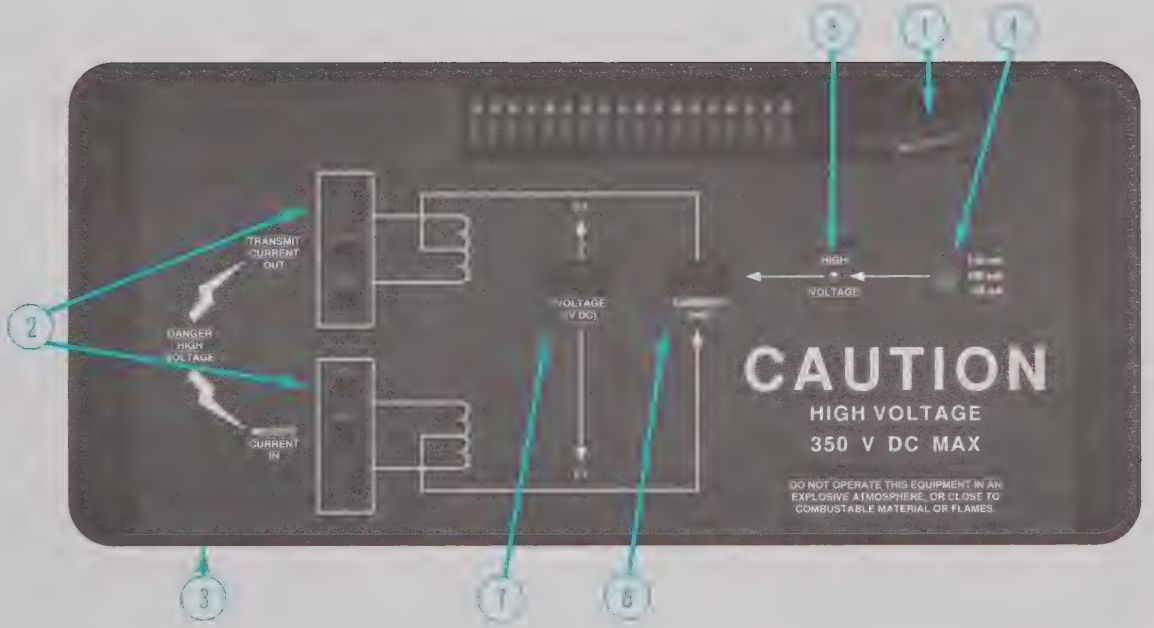

Figure 4-1
T-BERD Repeater Power Supply Front Panel

Complies with UL1459, Telephone Equipment, 1st and 2nd Editions, as tested and listed by a National Recognized Testing Laboratory (NRTL).

WARNING: It is of the upmost importance that the T-BERD Repeater Power Supply be operated by qualified technicians only in accordance with the safety warnings and instructions contained in this manual and printed on the front panel of the unit. Failure to do so could result in serious personal injury. Carefully read Section 4.7, Safety, before operating the T-BERD Repeater Power Supply.

4.7 REPEATER POWER SUPPLY — SAFETY

The following safety precautions and features **must be read** before operating the T-BERD Repeater Power Supply.

4.7.1 Safety Considerations

The T-BERD Repeater Power Supply provides up to 260 VDC and up to 140 mA to the T-Carrier span. Therefore, qualified personnel operating this unit must do so in accordance with the instructions and warnings contained in this manual and printed on the T-BERD Repeater Power Supply.

A maximum voltage of 260 VDC can cause fatal injury if the current is sufficient. The electrical hazard from the T-BERD Repeater Power Supply exists whenever the power is turned on.

The red High Voltage LED is a visual indication that power is on. When power is on, personnel must be aware of the safety hazards and act accordingly.

CAUTION: The T-BERD Repeater Power Supply delivers a constant current source of 60 mA, 100 mA, or 140 mA. The output voltage will vary up to 260 VDC, depending on the number of repeaters powered, span line length, and wire gauge. When the circuit is disconnected, the potential across the terminals can be as much as 350 VDC.

4.7.2 Safety Features

Attention should be given to the following safety features before beginning operation.

- The T-BERD Repeater Power Supply voltage is not relative to ground and does not seek ground through the technician in case of accidental contact across a pair of leads.
- The voltage output is not sent to the office side of the line, since it is only provided to the tip side of the connections at the distribution frame lightning protection block.
- A low-current sensing circuit pulses the output current in the following manner:
    1. When the output current is below 40 mA, the output signal is pulsed on for 10 ms and off for 800 ms.
    2. When the output current is above 40 mA, the output signal continues to pulse for five seconds and then engages on continuously until current falls below 40 mA.
- The red High Voltage LED illuminates when the unit is turned on and voltage is applied to the transmit and receive connectors.
- A bright yellow caution label on the front panel reads:

CAUTION

HIGH VOLTAGE
350 VDC MAX

DO NOT OPERATE THIS EQUIPMENT IN AN EXPLOSIVE ATMOSPHERE, OR CLOSE TO COMBUSTIBLE MATERIAL OR FUMES

- Another bright yellow caution label on the front panel reads:

DANGER
HIGH
VOLTAGE

- **WARNINGs** have been placed in the manual to indicate unsafe actions that can result in serious personal injury. These warnings must be understood and followed.

CAUTION: To prevent internal damage to the T-BERD Repeater Power Supply, use only 120 VAC to power the unit.

WARNING Persons with cardiac conditions are at an increased risk of fatal injury when operating the T-BERD Repeater Power Supply. Pregnant women should avoid using the unit, and it should be kept out of the reach of children.

WARNING Do not use the T-BERD Repeater Power Supply in areas of moisture or condensation.

4.8 REPEATER POWER SUPPLY — CONNECTION TO T-BERD 209A

Attach the T-BERD Repeater Power Supply to the T-BERD 209A by connecting the T-BERD Repeater Power Supply Mainframe Interconnect Cable (coiled cable with 15-pin D connector) to the T-BERD 209A 15-pin D connector. The cable provides the T1 signal interface for the T-BERD 209A.

The Mainframe Interconnect Cable can also be used to create a hard loopback of the received T1 test pattern at the T-BERD Repeater Power Supply. This hard loopback is established by attaching the Loopback Connector to the Mainframe Interconnect Cable 15-pin D connector. Establishing the hard loopback at the T-BERD Repeater Power Supply enables a technician to take the T-BERD 209A to mid-span for troubleshooting. The signal level at the distribution frame should be measured prior to using the Loopback Connector and should be -15 dBdsx or greater to ensure proper operation.

4.9 REPEATER POWER SUPPLY — T1 SPAN TESTING 2

Connect the T-BERD Repeater Power Supply to the T1 span at the central office distribution frame with either a W4CJ test access cord for 303-type protection blocks, or a W4BR test access cord for 302- and 308-type protection blocks.

The T-BERD Repeater Power Supply TRANSMIT CURRENT OUT and RECEIVE CURRENT IN jacks provide the connections between the T-BERD Repeater Power Supply and the T1 span. There are two sets of jacks for both the transmit and receive sides. One set is compatible with a dual WECO 310 jack, and the other set is compatible with a dual bantam jack. The TIP and RING signals are provided on the tips of the dual connectors, and the shields of the jacks are not connected. These dual jacks are compatible with cables used in the central office to access signals at the distribution frame lightning protectors.

4.10 REPEATER POWER SUPPLY — AC POWER CONNECTION 3

Connect the T-BERD Repeater Power Supply to a 120 VAC, 60 Hz power outlet with the three-prong power cord supplied with the instrument. The T-BERD Repeater Power Supply AC power receptacle is located on the bottom side of the cover. The **AC Power** switch and fuse compartment are located next to the receptacle.

WARNING Do *not* apply power to the T-BERD Repeater Power Supply at this point!

NOTE If power is applied to the T-BERD Repeater Power Supply, the High Voltage LED is illuminated.

4.11 REPEATER POWER SUPPLY — CURRENT SETTING 4

Press the **60 mA 100 mA 140 mA** switch to select the desired simplex current for the T1 span. The setting is determined by the user, and is based on the repeater type used in the span.

4.12 REPEATER POWER SUPPLY — APPLYING POWER (5)

Press the **AC Power** switch to apply power to the T-BERD Repeater Power Supply. The following indicators illuminate:

High Voltage LED (6) — The red LED indicates that power is being applied to the unit and that high voltage is being delivered across the transmit and receive pairs. The LED illuminates continuously when the current loop is established. The LED flashes if power is applied to the T-BERD Repeater Power Supply and the current loop is not established. While the LED is flashing, current is being pulsed on the span.

CURRENT (mA) Display (7) — The display provides a three-digit readout of the current being drawn by the T-Carrier circuit. It has a range of 0 mA to 399 mA. The readout is only valid when the High Voltage LED is illuminated continuously.

VOLTAGE (VDC) Display (8) — The display provides a three-digit readout of the voltage applied to the circuit. It has a range of 0 VDC to 399 VDC. The readout is only valid when the High Voltage LED is illuminated continuously.

When the circuit current path is established, the red High Voltage LED remains on continuously. The VOLTAGE and CURRENT displays reflect the current and voltage on the circuit.

To determine if the measured voltage is correct for the span being tested, calculate the expected span line voltage drop with the following formula. The V_{rpt} and V_{drop} can be found in Tables 4-2 and 4-3 respectively.

Total V_{drop} = (# repeaters X V_{rpt}) + (V_{drop} X kft of cable)

- If the transmit and receive connections are reversed, the measured voltage will be much less than the expected voltage. Typically, V_{rpt}, when current is reversed, is between 1 and 2 volts.
- Allow for any extra voltage drop required for office repeaters and NIUs. The typical voltage drop for transmission devices is 8 to 16 volts each.
- Allow for additional CSU voltage drops of 14 to 24 volts.

Table 4-2
Typical Repeater Voltage Drop

	Voltage Drop/Repeater (V_{rpt})		
Repeater Type	**60 mA**	**100 mA**	**140 mA**
238 A/B	7.0	7.1	7.2
239 A/B	7.6	8.2	8.7
239E	8.4	9.6	10.7

Table 4-3
Typical Cable Gauge Voltage Drop

	Voltage Drop/kft (V_{drop})		
Cable Gauge	**60 mA**	**100 mA**	**140 mA**
26	2.7	4.5	6.3
24	1.7	2.8	4.0
22	1.1	1.8	2.6
19	0.5	0.8	1.2

If these indicators do not illuminate, check the fuse in the AC power receptacle. If the fuse is open, replace it with a 1 A fast-blow fuse (1 A AGC 3). Refer to the *T-BERD Repeater Power Supply Operating Manual* (ML11251) to replace the fuse.

T-BERD DLC ANALYZER OPTION

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PRINTER CONTROL

T-BERD DLC ANALYZER OPTION

4.13 DLC ANALYZER OPTION — INTRODUCTION

This section describes the T-BERD DLC Analyzer Option (see Figure 4-4) which attaches to the T-BERD209A to provide additional SLC-96 system testing capabilities.

The T-BERD DLC Analyzer is a portable test instrument that can test Digital Loop Carrier (DLC) systems during circuit installation, acceptance testing, and troubleshooting applications. It can monitor and generate alarms, far-end loops, switch to protection events, and maintenance test sequences over the DLC datalink. The T-BERD DLC Analyzer also has the capability to monitor the channel signaling of all 24 DS0 channels and test the channel signaling of individual DS0 channels.

4.14 DLC ANALYZER OPTION — FEATURES

The T-BERD DLC Analyzer Option offers the following features and capabilities:

Tests circuits that have either T1 D4, T1 D1D, T1 ESF, or T1 SLC-96 framing.

Drops and inserts SLC-96 datalink and T1 channel information.

SLC-96 datalink major, minor, and power/miscellaneous alarms are reported on the front panel and can be generated to test terminal alarm circuits.

Automated maintenance test procedure can be initiated from the T-BERD DLC Analyzer.

Far-end loopbacks can be established over a given shelf or protection line. The selected shelf is automatically switched to the protection line when placed in loopback.

Switch to protection line can be initiated for a given shelf.

On-hook, off-hook, and ringing conditions can be generated from dedicated switches.

A, B, C, and D channel signaling bits can be monitored on all channels or timeslots simultaneously.

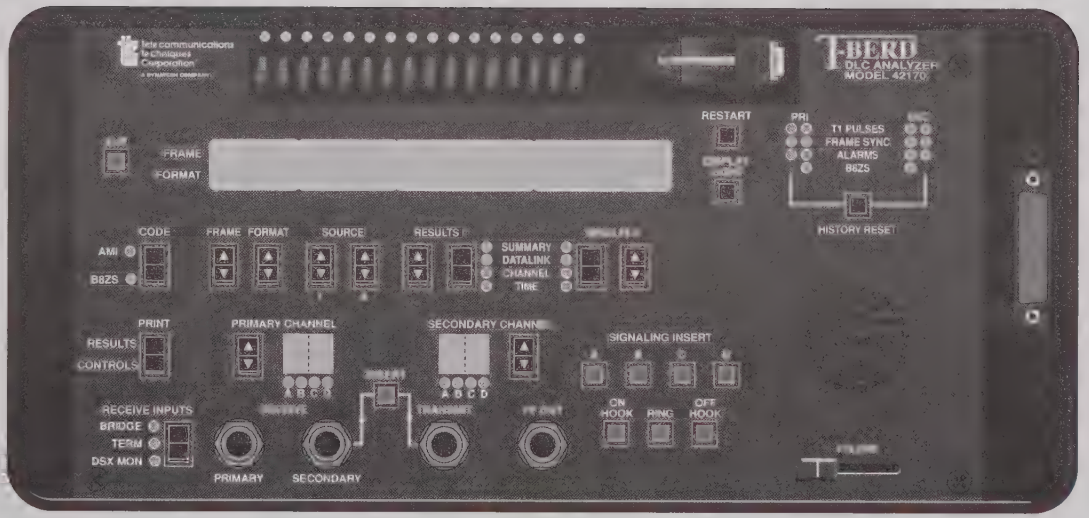


Figure 4-4
T-BERD DLC Analyzer Option Front Panel

SLC-96 Mode 2 timeslot channel assignments can be requested and displayed on the front panel.

VF outputs enable DS0 channels or timeslots to be analyzed by external TIMS test sets or listened to over a built-in speaker.

VF signal level and frequency can be measured for individual DS0 channels or timeslots.

404, 1004, and 2804 Hz tones can be inserted into individual DS0 channels or timeslots.

Decodes DTMF dialing sequences and displays the dialed number of the received signal.

2-wire VF input/output enables two-way testing over a selected DS0 channel or timeslot.

4.15 DLC ANALYZER OPTION — FUNCTIONAL DESCRIPTION

The T-BERD DLC Analyzer can generate and report on the status of datalink alarm, far-end loopback, maintenance, and switch to protection line messages. Alarm messages indicate various system conditions that cause failures in signal quality, loss, or line backup capabilities. Far-end loopback messages indicate which DS1 line is looped back (Shelf A, B, C, D, or protection line). The maintenance messages indicate the messages being transmitted when the maintenance test procedure is performed. Protection line switch messages indicate which of the primary DS1 lines has been switched to the protection line.

When configuring the T-BERD DLC Analyzer to transmit and receive SLC-96 datalink signals, the T-BERD DLC Analyzer automatically frames to either the received Network Office Terminating Equipment (NOTE) and WP1B Alarm Control Unit (ACU) 16-bit datalink alarm message format or the WP1 ACU 13-bit datalink alarm message format. The available alarm messages for the NOTE, WP1B ACU, and WP1 ACU are listed in Table 4-4. The T-BERD DLC Analyzer transmits whatever alarm message format it receives.

Table 4-4
NOTE and ACU Alarm Messages

NOTE	WP1 ACU	WP1B ACU
Major Alarm	Major Alarm	Major Alarm
Shelf A Alarm	Minor Alarm	Minor Alarm
Shelf B Alarm	Power/Misc. Alarm	Power/Misc. Alarm
Shelf C Alarm	Shelf A Alarm	Shelf A Alarm
Shelf D Alarm	Shelf B Alarm	Shelf B Alarm
	Shelf C Alarm	Shelf C Alarm
	Shelf D Alarm	Shelf D Alarm
	Shelf A Far-End Loop	Shelf A Far-End Loop
	Shelf B Far-End Loop	Shelf B Far-End Loop
	Shelf C Far-End Loop	Shelf C Far-End Loop
	Shelf D Far-End Loop	Shelf D Far-End Loop
	Protection Line Far-End Loop	Protection Line Far-End Loop

The alarm messages are categorized as major and minor alarms. Major alarms identify system failures that prevent subscriber access to the network; i.e., signal loss, datalink failure, loss of frame synchronization, and power/miscellaneous alarms identified as major alarms. Minor alarms identify protection line failure, power/miscellaneous alarms identified as minor alarms, and shelf loopback conditions.

The T-BERD DLC Analyzer can also initiate and monitor the automated maintenance test procedure. The received maintenance messages indicate the sequence that takes place when a customer loop is requested to be connected to the bypass pair.

Channel signaling (on hook, off hook, and ring) can be generated and monitored when the T-BERD DLC Analyzer is connected to a SLC shelf and an individual channel is selected. The individual signaling bits (A, B, C, and D) can be manipulated individually through front-panel switches, or through dedicated on-hook, off-hook, and ringing control switches.

4.16 DLC ANALYZER OPTION — CONNECTING TO T-BERD 209A

The T-BERD DLC Analyzer coiled cable attaches to the T-BERD209A 15-pin D connector. The T-BERD DLC Analyzer receives power through this cable.

4.17 DLC ANALYZER OPTION — TEST SETUP

The following controls and indicators (see Figure 4-5) are described in the order that you would normally use them to set up the T-BERD DLC Analyzer to test a circuit from an DSX-1 access point.

- Front-Panel display (1)
- **DISPLAY LIGHT** switch (2)
- **AUX** switch (3)
- **CODE** switch (4)
- **FRAME** switch (5)
- **FORMAT** switch (6)
- **SOURCE I** and **II** switches (7)
- **PRIMARY CHANNEL** switch (8)
- **SECONDARY CHANNEL** switch (9)

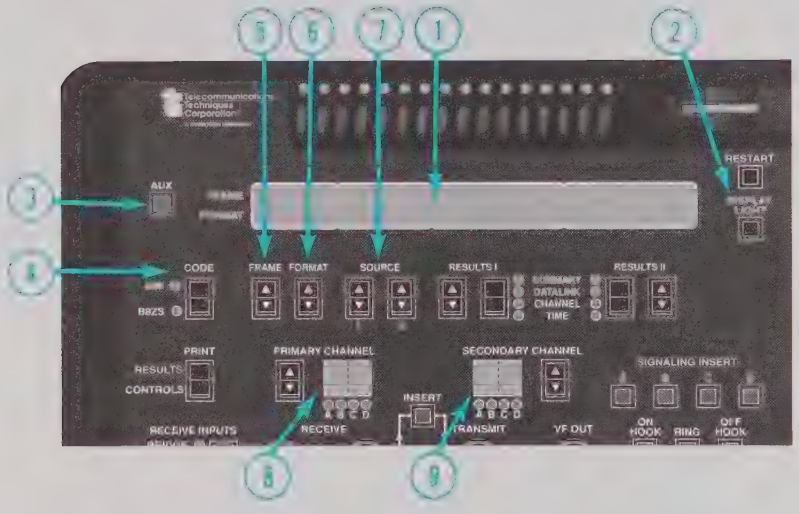


Figure 4-5
Test Setup Controls and Indicators

Front-Panel Display (1)

Operating modes, test results, test patterns, and auxiliary functions are displayed in the four window, two-line, liquid crystal display (LCD). The display is also backlighted for easier viewing in subdued lighting.

The first window (from left to right) indicates the current framing mode (FRAME window) and format (FORMAT window) of the instrument. The displayed information is selected by pressing the **FRAME** and **FORMAT** switches.

The second window indicates the current source test signal for the selected framing and format modes. The SOURCE I line is controlled with the **SOURCE I** switch, and the SOURCE II line is controlled with the **SOURCE II** switch.

The third window is identified as the RESULTS I window, and the fourth window is identified as the RESULTS II window. The RESULTS I window is controlled by the two **RESULTS I** switches just below the window. The RESULTS II window is controlled by the two **RESULTS II** switches just below the window. These windows display the test results, auxiliary function selections, and status messages.

DISPLAY LIGHT Switch (2)

Press this switch to backlight the display in low light conditions. Press the switch once to backlight the display for 30 seconds. Press the switch again during the 30 seconds and the display remains illuminated. Press the switch a third time to turn the illumination off.

AUX Switch (3)

Press this switch to access the auxiliary functions. The switch LED illuminates when the auxiliary functions appear in the display. Auxiliary functions allow access to parameters that are less frequently used and do not have dedicated switches. When the **AUX** switch is pressed a second time, the switch LED goes out and the display returns to its normal operating display. Refer to Section 5 for detailed information on the following auxiliary functions.

CHANNEL/VF DROP	T1 Source for Channel VF Drop
CHANNEL/CHANNEL SCROLL	Channel Scroll
CHANNEL/TRUNK TYPE	Channel Trunk Type
TRANSMIT/LBO	T1 Transmitter Line Build-Out
TIME/SET TIME	Set Time of Day
TIME/SET DATE	Set Date

CODE Switch (4)

Press this two-position switch to set the transmitted coding for either AMI-encoded data or B8ZS clear-channel encoded data. The LEDs adjacent to the switch illuminate to indicate the current selection. The **CODE** switch only affects the transmitter; B8ZS decoding is performed automatically at the receiver.

Switch Configurations

The **FRAME**, **FORMAT**, **SOURCE I**, and **SOURCE II** switches are interrelated. They configure the T-BERD DLC Analyzer to the circuit framing mode and select a signal for insertion into either the selected DS0 channel or SLC-96 datalink. Table 4-5 lists the available switch

Table 4-5
Mode 1 SLC-96 Datalink Source Test Signals

Switch	Configuration			
FRAME	SLC-M1			
FORMAT	DATLINK			
SOURCE I	MAJOR	FE LOOP	SW PROT	MINOR, PWR/MISC, MAINT, and IDLE
SOURCE II	SHELF A SHELF B SHELF C SHELF D NO SHELF	SHELF A SHELF B SHELF C SHELF D PROTECT	SHELF A SHELF B SHELF C SHELF D	

selections to test a Mode 1 SLC-96 (SLC-M1) circuit from the Shelf A datalink. Table 4-6 lists the available switch selections to test a Mode 2 SLC-96 (SLC-M2) circuit from either the Shelf A or C datalink. Table 4-7 lists the available tones and levels, as well as a 2-wire interface, that can be used to test a DS0 channel. The switches and selections are described in the following sections.

Table 4-6
Mode 2 SLC-96 Datalink Test Signals

Switch	Configuration			
FRAME	SLC-M2			
FORMAT	DATLINK			
SOURCE I	MAJOR	FE LOOP	SW PROT	MINOR, PWR/MISC, IDLE, and MAPPINGS
SOURCE II	SHELF A SHELF B SHELF C SHELF D NO SHELF	SHELF A SHELF B SHELF C SHELF D PROTECT	SHELF A SHELF B SHELF C SHELF D	

Table 4-7
DS0 Channel Test Signals

Switch	Configuration			
FRAME	SLC-M1, SLC-M2, T1 D1D, T1 D4, and T1 ESF			
FORMAT	CHANNEL			
SOURCE I	404 Hz	1004 Hz	2804 Hz	VF INTF
SOURCE II	-16 dBm -10 dBm -3 dBm 0 dBm +3 dBm	-16 dBm -10 dBm -3 dBm 0 dBm +3 dBm	-16 dBm -10 dBm -3 dBm 0 dBm +3 dBm	

FRAME Switch (5)

Press this switch to select the transmitted framing mode and to configure both receivers for the expected framing mode. The framing mode appears in the FRAME window. Holding the switch automatically scrolls the framing modes in the window. Releasing the switch activates the indicated framing mode and initiates a test restart. The framing modes include:

SLC-M1 — Configures the T-BERD DLC Analyzer to transmit and receive a SLC-96 (Mode 1) signal.

SLC-M2 — Configures the T-BERD DLC Analyzer to transmit and receive a SLC-96 (Mode 2) signal.

T1 D1D — Configures the T-BERD DLC Analyzer to transmit and receive a D1D framed T1 signal.

T1 D4 — Configures the T-BERD DLC Analyzer to transmit and receive a D4 framed T1 signal.

T1 ESF — Configures the T-BERD DLC Analyzer to transmit and receive a ESF framed T1 signal.

AUTO — Automatically configures to a received SLC-96 (Mode 1), T1 D1D, or T1 ESF framed signal. When the T-BERD DLC Analyzer searches for the framing format, the message *scan...* appears in the FORMAT window. When the framing is detected, the framing mode name appears in the FRAME window in lowercase characters.

FORMAT Switch (6)

This switch selects the bandwidth that the source test signal (see **SOURCE** switches) is inserted into when the **INSERT** switch is pressed. The source test signal is inserted into one of the following bandwidths:

CHANNEL — Enables access to the DS0 channels or timeslots. An internally generated tone, externally generated signal, and/or channel signaling can be inserted into the selected DS0 channel or timeslot. The **SIGNALING INSERT** switches are active only in this format.

DATLINK — Enables access to the SLC-96 datalink. This allows alarm, maintenance, far-end loop, switch to protection line, idle, and timeslot request messages to be sent to the remote terminal, switch, or central office terminal. DATLINK is only available in the SLC-M1 and SLC-M2 framing modes. If DATLINK is selected and the framing is changed to a non-SLC mode, the format defaults to CHANNEL. If the framing mode is changed to AUTO and the T-BERD DLC Analyzer gains frame synchronization with a non-SLC mode, the format is changed to CHANNEL.

The **FORMAT** switch is disabled whenever *scan...* appears.

Source Test Signal Switches (7)

The **SOURCE I** and **SOURCE II** switches work in conjunction with the **FRAME** and **FORMAT** switches to select source test signals (tones, levels, alarms, or circuit requests) that can be inserted into either a DS0 channel/timeslot or the SLC-96 datalink when the **INSERT** switch is illuminated. The selected source test signal is inserted into the T1 signal that passes through the T-BERD DLC Analyzer from the SECONDARY RECEIVE input to the TRANSMIT output. The inserted source test signal overwrites the information in the selected DS0 channel or datalink field.

SOURCE I Switch

Press this switch to scroll through and select the source test signals displayed in the SOURCE I line. The source test signals are dependent on the selected format (CHANNEL or DATLINK) and framing mode.

When the **FORMAT** switch is set to CHANNEL, the T-BERD DLC Analyzer can be configured to insert one of three tones or the input from a 2-wire interface into the selected DS0 channel or timeslot when the **INSERT** switch LED is illuminated. The DS0 channel or timeslot is selected with the **SECONDARY CHANNEL** switch. The source test signals include:

404 Hz, 1004 Hz, or 2804 Hz — Select one of the internally generated tones to insert on the selected DS0 channel or timeslot. The output level is selected with the **SOURCE II** switch.

VF INTF — Select the external 2-wire interface to insert an externally generated signal (e.g., voice, tones, etc.) on the selected DS0 channel or timeslot. When the CHANNEL format is selected, the T-BERD DLC Analyzer overwrites any signaling information from the VF INTF. When the DATLINK format is selected, the signaling passes through the T-BERD DLC Analyzer from the SECONDARY RECEIVE input.

When the **FORMAT** switch is set to DATLINK, the T-BERD DLC Analyzer can be configured to insert alarms, far-end loop, switch to protection line, maintenance test, idle, or timeslot mapping messages into the SLC-96 datalink when the **INSERT** switch LED is illuminated. To test from the datalink, the T-BERD DLC Analyzer should be connected to either Shelf A in a Mode 1 SLC-96 circuit or Shelf A or C in a Mode 2 SLC-96 circuit. If the T-BERD DLC Analyzer has SLC frame synchronization but no datalink synchronization, all datalink information is passed through the T-BERD DLC Analyzer. The source test signals include:

MAJOR — Send a major alarm with or without an accompanying shelf alarm. Select the shelf or no shelf with the **SOURCE II** switch.

MINOR — Sends the minor alarm message.

PWR/MISC — Sends the power/miscellaneous alarm message.

FE LOOP — Sends the far-end loop command to loop back the selected shelf. A minor alarm message is also transmitted. Select the shelf or protection line with the **SOURCE II** switch. The selected shelf is automatically switched to the protection line to prevent customer interruption.

SW PROT — Sends the switch to protection line command to switch the selected shelf to the protection line. Select the shelf with the **SOURCE II** switch. If the switch to the protection line is successful, the message *P/S SHELF x ON PROT* appears in the

SUMMARY and DATALINK categories. If the switch to the protection line fails, the message *SW PROT FAILED* flashes in the SUMMARY category. If another line is already on the protection line when the command is sent, the T-BERD DLC Analyzer flashes the message *SW PROT FAILED* in the SUMMARY category and waits until the protection line is cleared to switch the selected shelf to the protection line.

MAINT — Sends the automated maintenance test sequence. This emulates central office equipment performing an automated maintenance test. The test sequence is displayed in the SOURCE II line. It is assumed that the T-BERD DLC Analyzer is connected to Shelf A. Responses to the test sequence can be monitored in the SUMMARY and DATALINK categories. Select the DS0 channel to be tested with the **SECONDARY CHANNEL** switch.

IDLE — Sends the idle message on the datalink. Alarms are not indicated, shelves are not switched to the protection line, and the maintenance test does not continue.

MAPPINGS — Sends a request to the central office equipment for the Mode 2 SLC-96 timeslot channel assignments. This is only available in the SLC-M2 mode. The responses are displayed in the CHANNEL category P/S TS CH result.

SOURCE II Switch

Press this switch to scroll through and select the source test signals displayed in the SOURCE II line. The source test signals are dependent on the SOURCE I selection. In some cases a SOURCE I selection does not have a SOURCE II selection and the **SOURCE II** switch is disabled.

When the **FORMAT** switch is set to CHANNEL, the **SOURCE II** switch selects the output level for the selected tone shown in the SOURCE I line. The source test signal levels include:

-16 dBm, -10 dBm, -3 dBm, 0 dBm, and +3 dBm — Select the desired output level for the selected tone.

When the **FORMAT** switch is set to DATLINK, the **SOURCE II** switch selects the shelf or line that an alarm, far-end loop, or switch to protection line message is assigned.

SHELF A, SHELF B, SHELF C, SHELF D, or NO SHELF — When MAJOR alarm is selected with the **SOURCE I** switch, select the desired shelf or no shelf to identify the major alarm.

SHELF A, SHELF B, SHELF C, SHELF D, or PROTECT — When FE LOOP is selected with the **SOURCE I** switch, select the desired shelf or protection line to loopback. When a shelf is looped back, the shelf automatically switches to the protection line.

SHELF A, SHELF B, SHELF C, or SHELF D — When SW PROT is selected with the **SOURCE I** switch, select the shelf that is going to be switched to the protection line.

MAINT Messages — During the automated maintenance test, the maintenance test sequence messages being transmitted appear in lowercase characters in the SOURCE II line.

PRIMARY CHANNEL Switch (8)

Press this switch to select the DS0 channel or timeslot to be dropped from the T1 signal that is received at the PRIMARY RECEIVE jack. This enables the T-BERD DLC Analyzer to monitor the selected DS0 channel or timeslot through the internal speaker, measure the VF level and frequency, and monitor the channel data bits and DTMF dialed telephone numbers. Changing the channel number clears the CHANNEL category primary results.

For all the framing modes except SLC-M2, the number displayed in the Primary Channel display indicates the selected channel from 1 to 96. In SLC-M2 framing, the Primary Channel display indicates the selected timeslot from 1 to 48. A double dash (— —) indicates that a channel or timeslot is not selected. Table 4-8 identifies the shelves and the associated channel numbers for a typical SLC-96 channel numbering scheme.

The **PRIMARY CHANNEL** switch and **SECONDARY CHANNEL** switch can select channels or timeslots separately or simultaneously through the CHANNEL/CHANNEL SCROLL auxiliary function. Set the CHANNEL/VF DROP auxiliary function to either PRIMARY or BOTH to analyze the selected primary T1 signal DS0 channel or timeslot.

Table 4-8
SLC-96 Channel Numbering Scheme

Shelf	Plug-In Circuit Channel Numbers											
D	73|74	75|76	77|78	79|80	81|82	83|84	85|86	87|88	89*|90	91*|92	93*|94	95*|96
C	49|50	51|52	53|54	55|56	57|58	59|60	61|62	63|64	65*|66	67*|68	69*|70	71*|72
B	25|26	27|28	29|30	31|32	33|34	35|36	37|38	39|40	41*|42	43*|44	45*|46	47*|48
A	1|2	3|4	5|6	7|8	9|10	11|12	13|14	15|16	17*|18	19*|20	21*|22	23*|24

* In Mode 2 operation where single circuit plug-ins are used, the asterisk indicates the channel number that is assigned to the timeslot.

Primary Channel ABCD Signaling LEDs

The four LEDs indicate the status of the signaling bits for the selected channel received on the PRIMARY RECEIVE jack.

SECONDARY CHANNEL Switch (9)

This switch performs three functions.

- Selects the DS0 channel or timeslot to be dropped from the secondary T1 signal received at the SECONDARY RECEIVE jack. This enables the T-BERD DLC Analyzer to monitor the selected DS0 channel or timeslot through the internal speaker, measure the VF level and frequency, and monitor the channel data bits and DTMF dialed telephone numbers. Changing the channel number clears the CHANNEL category secondary results.

- Selects the DS0 channel or timeslot that a source test signal and channel signaling bits can be inserted into when the **INSERT** switch is illuminated and the **FORMAT** switch is set to CHANNEL.

- Selects the DS0 channel or timeslot that is placed on the bypass pair when the maintenance test sequence is performed from the T-BERD DLC Analyzer when the **INSERT** switch is illuminated and the **FORMAT** switch is set to DATLINK.

For all the framing modes, except SLC-M2, the number displayed in the Secondary Channel display indicates the selected channel from 1 to 96. In SLC-M2 framing, the Secondary Channel display indicates the selected timeslot from 1 to 48. A double dash (— —) indicates that a channel or timeslot is not selected. Select the desired channel or timeslot before plugging into a shelf. Table 4-8 identifies the shelves and the associated channel numbers for a typical SLC-96 channel numbering scheme.

The **PRIMARY CHANNEL** switch and **SECONDARY CHANNEL** switch can select channels or timeslots separately or simultaneously through the CHANNEL/CHANNEL SCROLL auxiliary function. Set the CHANNEL/VF DROP auxiliary function to either SECONDARY or BOTH to analyze the selected secondary T1 signal DS0 channel or timeslot.

Secondary Channel ABCD Signaling LEDs

The four LEDs indicate the status of the signaling bits for the selected channel received on the SECONDARY CHANNEL jack.

4.18 DLC ANALYZER OPTION — CIRCUIT CONNECTIONS

The front-panel connections allow the T-BERD DLC Analyzer to receive two T1 signals simultaneously and transmit one T1 signal. Additional connections allow for VF inputs and outputs. Figure 4-6 illustrates the location of the following connections.

- PRIMARY RECEIVE jack (10)
- SECONDARY RECEIVE jack (11)
- **RECEIVE INPUT** switch (12)
- TRANSMIT jack (13)
- **INSERT** switch (14)
- 4-Wire VF OUT jack (15)
- 2-Wire VF posts (16)

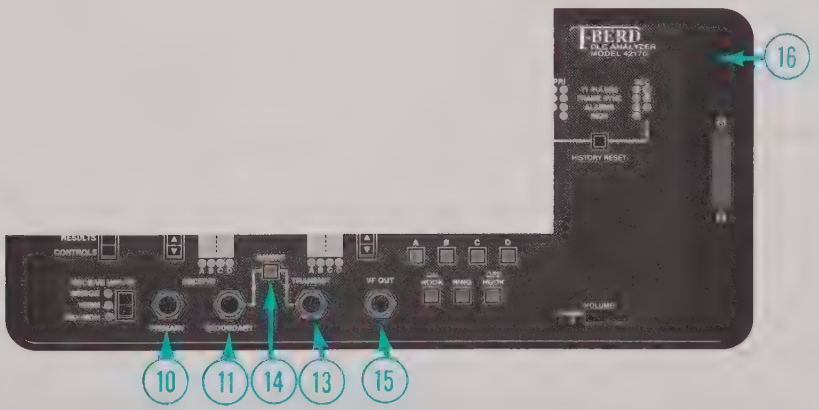


Figure 4-6
T-BERD DLC Analyzer Circuit Connections

PRIMARY RECEIVE Jack (10)

This WECO 310 jack accepts a T1 signal to be monitored and analyzed by the T-BERD DLC Analyzer. The input impedance and signal conditioning are controlled through the **RECEIVE INPUT** switch.

SECONDARY RECEIVE Jack (11)

This WECO 310 jack accepts a T1 signal to be monitored and analyzed by the T-BERD DLC Analyzer. The received T1 signal is also retransmitted through the TRANSMIT jack which enables a source test signal to be inserted into one of the DS0 channels, timeslots, or SLC-96 datalink. The received secondary T1 signal provides recovered timing for the transmitted signal at the TRANSMIT jack. The input impedance and signal conditioning are controlled through the **RECEIVE INPUT** switch.

RECEIVE INPUT Switch (12)

This switch sets the input impedance and signal conditioning for the PRIMARY RECEIVE and SECONDARY RECEIVE jacks. The selections include:

BRIDGE — This setting provides an impedance of greater than 1000 ohms to connect across a terminated line.

TERM — This setting provides an impedance of 100 ohms to terminate a connection.

DSX-MON — This setting provides an impedance of 100 ohms and amplification to monitor a T1 signal from a DSX-1 monitor point.

TRANSMIT Jack (13)

This WECO 310 jack provides the T1 output for the T-BERD DLC Analyzer. The output can be transmitted in one of the following forms:

- The unaffected T1 signal from the SECONDARY RECEIVE jack when the **INSERT** switch is not illuminated.
- The T1 signal from the SECONDARY RECEIVE jack with a source test signal inserted into a selected DS0 channel or timeslot when the **INSERT** switch is illuminated and the CHANNEL format is selected. The datalink passes through unaffected.

- The T1 signal from the SECONDARY RECEIVE jack with a datalink signal inserted into the SLC-96 datalink when the **INSERT** switch is illuminated and the DATLINK format is selected. The DS0 channels or timeslots (data and signaling) pass through unaffected.

The output level is controlled through the TRANSMIT/LBO auxiliary function and terminated into 100 ohms. The transmitted output timing is taken from the recovered clock of the SECONDARY RECEIVE input, or from an internal clock when the T1 signal is not connected to the SECONDARY RECEIVE input. Before connecting the TRANSMIT output to a shelf, disable the **INSERT** switch (not illuminated) to prevent inadvertent source test signal insertion from the T-BERD DLC Analyzer.

INSERT Switch (14)

This switch controls the insertion of the source test signal (channel tones, channel signaling bits, and datalink messages) into the T1 signal transmitted from the TRANSMIT output jack. When the switch LED is illuminated, the source test signal is inserted into the transmitted T1 signal. When the switch LED is not illuminated, the inserted source test signal is suspended and the T1 signal passes through the T-BERD DLC Analyzer unaffected. The insert mode is functional only when the T-BERD DLC Analyzer has frame synchronization.

The following conditions cause the **INSERT** switch to flash for three seconds in which time the T-BERD DLC Analyzer is reconfigured and the new selection is inserted into the T1 signal.

- Pressing the **INSERT** switch when it is not illuminated.
- Changing the **FORMAT** switch selection.
- Changing either the **SOURCE I** or **SOURCE II** switch when the **FORMAT** switch is set to DATLINK.
- Changing the **SECONDARY CHANNEL** switch when the **FORMAT** switch is set to DATLINK and the maintenance test is being performed.
- Changing the **SECONDARY CHANNEL** switch when the **FORMAT** switch is set to CHANNEL.

During the three seconds, the inserted source test signal is temporarily inhibited, the instrument is reconfigured, and the T1 signal from the SECONDARY RECEIVE input is passed on to the TRANSMIT output unaffected. When the **INSERT** switch LED stops flashing and illuminates, the new source test signal is inserted into the T1 signal.

VF OUT Jack (15)

This WECO 310 jack provides a 4-wire, 600 ohm termination, to drop a DS0 channel to an external device such as a TIMS test set. The output source is determined by the CHANNEL/VF DROP auxiliary function and the **SECONDARY CHANNEL** switch.

2-Wire VF Posts (16)

This 2-wire interface is located in the right-side inset of the T-BERD DLC Analyzer. The two posts allow a butt-set to be connected to the T-BERD DLC Analyzer for two-way access and control over the selected DS0 channel. The posts provide a 600 ohm termination. Select the 2-wire interface by setting the **SOURCE I** switch to VF INTF. The input and output source is determined by the CHANNEL/VF DROP auxiliary function, the **SECONDARY CHANNEL** switch, and the **INSERT** switch.

4.19 DLC ANALYZER OPTION — SIGNAL VERIFICATION

The following controls, indicators, and results are used to verify that the T-BERD DLC Analyzer has properly acquired the received DS1 signal from both receiver inputs (see Figure 4-7).

- Primary and Secondary Status LEDs (17)
- **HISTORY RESET** switch (18)
- **VOLUME** control (19)
- SUMMARY category messages

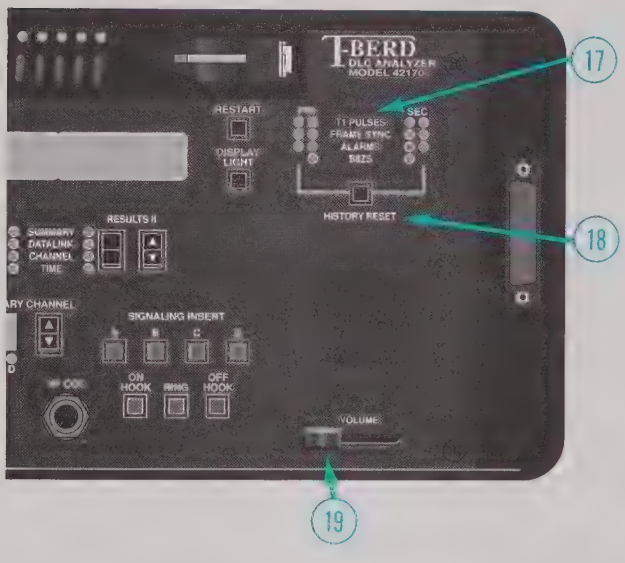


Figure 4-7
Signal Verification Controls and Indicators

Primary and Secondary Status LEDs 17

Four columns of LEDs, two columns for the PRIMARY RECEIVE input and two columns for the SECONDARY RECEIVE input, are used to indicate the current and history status of the received signal. The two inside columns provide the current status of the incoming T1 signal and the two outside columns indicate the history status. The green LEDs indicate a positive condition (e.g., signal present) and the red LEDs indicate history, alarm, or failure conditions (e.g., frame loss). Using two LEDs for each status condition allows the following conditions to be indicated:

Both LEDs Off — No occurrences of the corresponding condition, past or present.

Current LED On, History LED Off — The first occurrence of the condition.

Current LED OFF, History LED On — Past occurrence of the condition but no current detection.

Both LEDs On — Past and present occurrence of the condition.

The status LEDs are described as follows:

T1 Pulses — The green LED illuminates when valid T1 pulses are detected. The red history LED illuminates when T1 pulses are no longer detected after initial signal detection.

Frame Sync — The green LED illuminates when the T-BERD DLC Analyzer has achieved frame synchronization with the selected framing pattern (see **FRAME** switch). The red history LED illuminates when frame synchronization is lost, after initial frame synchronization.

Alarms — The current red LED illuminates when any of the following conditions is detected in the SLC datalink.

- Major alarms
- Minor alarms
- Power/miscellaneous alarms
- Shelf alarms
- Far-end loop event
- Switch to protection line event
- Automated maintenance test event

If the current LED is illuminated, check the SUMMARY and DATALINK categories for the current alarms and messages. If the history LED is illuminated, check the DATALINK category for the previously received alarms and messages.

B8ZS — The current green status LED illuminates when B8ZS clear channel encoding is detected in the received signal.

HISTORY RESET Switch 18

This switch clears the history LEDs that are currently illuminated and all non-current alarm messages in the DATALINK category.

VOLUME Control 19

This slide switch controls the output of the internal speaker. The speaker enables the selected DS0 channel to be monitored.

SUMMARY Category Messages

The SUMMARY category provides a convenient way to monitor specific non-zero results, messages, and measurements without having to search through the other categories. The SUMMARY category is selected by pressing either the **RESULTS I Category** switch or the **RESULTS II Category** switch. When the category is selected, the appropriate yellow LED illuminates.

During initial signal acquisition, the SUMMARY category should be displayed to watch for the following messages:

ALL RESULTS OK — This message appears after initial signal presence is detected on one input and no errors or alarms are detected.

ALL RESULTS UNAVAILABLE — This message appears at test restart when the instrument has not synchronized with the received signal or no signal is attached.

When an error or alarm is detected, the appropriate result appears in the SUMMARY category window. Each result is preceded with either a "P" (Primary) or "S" (Secondary) to indicate the input source. The SUMMARY category results are divided into four types of results: flashing messages, alarm messages, maintenance test messages, and T1 signal errors. The "x" in some of the results indicates a shelf or line designation, A, B, C, D, or PROTECT.

The flashing messages include:

P/S DATALINK SYNC LOSS
P/S SIGNAL LOSS
SW PROT FAILED
OPTION NOT INSTALLED

The current alarm messages include:

P/S ALARM SHELF x
P/S FE LOOP PROTECT
P/S FE LOOP SHELF x
P/S MAJOR NO SHELF
P/S MAJOR SHELF x
P/S MINOR
P/S PWR/MISC
P/S SHELF x ON PROT

The maintenance test messages include:

P/S MAINT HOOK/SEIZE
P/S MAINT PROCEED
P/S MAINT TEST ALARM

The T1 signal error results include:

P/S CRC ERROR (ESF framing only)
P/S FRM ERROR
P/S VIOLATION

Refer to Section 6 for more information on the results that appear in the T-BERD DLC Analyzer SUMMARY category.

4.20 DLC ANALYZER OPTION — STARTING TEST/COLLECTING RESULTS

Once the T-BERD DLC Analyzer is configured and connected to the circuit, use the following switches and indicators to initiate the test and collect test results. Figure 4-8 illustrates the switches and indicators required to verify the results.

- **RESTART** switch (20)
- **RESULTS** switches (21)
- Collecting test results

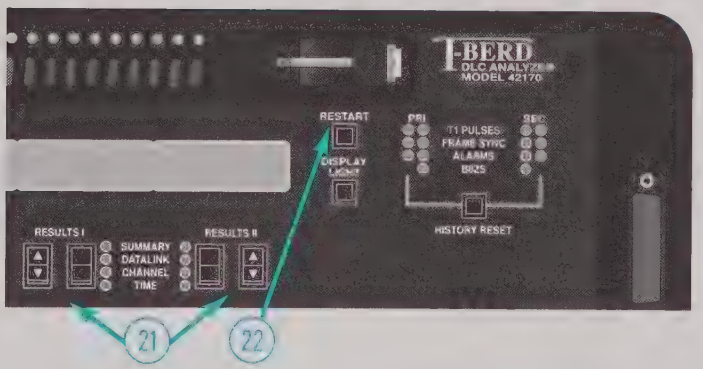


Figure 4-8
Controls to Start Tests and Collect Results

RESTART Switch (20)

This pushbutton switch restarts the test in progress. When pressed, all test results and status LEDs are cleared. A test is also restarted when the **FRAME** or **RECEIVE INPUT** switch is pressed.

RESULTS Switches (21)

When test results appear in the RESULTS I and RESULTS II windows, the categories and results are selected with the **RESULTS** switches below the windows.

RESULTS I Category Switch or RESULTS II Category Switch — Selects the category of results to be displayed. The labeled LEDs illuminate to indicated the selected category. Holding the switch automatically scrolls the categories.

RESULTS I Results Switch or RESULTS II Results Switch — Selects the individual results from the indicated category. Pressing this switch for more than one second automatically scrolls the entire list. Holding the switch automatically scrolls the results.

Collecting Test Results

During a test, the available results and alarm messages are continuously updated. The results are divided into four categories. During the test, the SUMMARY category displays key non-zero or alarm message results. Refer to Section 6 for more information on the test results. The available categories and results include:

SUMMARY Category — Lists key non-zero error results, flashing messages, or current alarm messages.

Flashing Messages
P/S SIGNAL LOSS
P/S DATALINK SYNC LOSS
SW PROT FAILED
OPTION NOT INSTALLED

Maintenance Messages
P/S MAINT PROCEED
P/S MAINT HOOK/SEIZE
P/S MAINT TEST ALARM

Current Alarm Messages
P/S MAJOR SHELF x
P/S MAJOR NO SHELF
P/S ALARM SHELF x

P/S SHELF x ON PROT
P/S FE LOOP PROTECT
P/S FE LOOP SHELF x
P/S MINOR
P/S PWR/MISC

T1 Signal Errors
P/S VIOLATION
P/S FRM ERROR
P/S CRC ERROR (ESF framing only)

DATALINK Category — Lists SLC datalink related results, current and history alarms, and maintenance test messages.

Alarm Messages
P/S MAJOR SHELF x
P/S MAJOR NO SHELF
P/S ALARM SHELF x
P/S SHELF x ON PROT
P/S FE LOOP PROTECT
P/S FE LOOP SHELF x
P/S MINOR
P/S PWR/MISC

Maintenance Messages
P/S MAINT PROCEED
P/S MAINT HOOK/SEIZE
P/S MAINT TEST ALARM

Datalink Results
P/S SLC A SEC
P/S DL BITS
P/S ALM FIELD

CHANNEL Category — Lists results for timeslot or channel signaling bits, data bits, channel assignments, and measurements.

Channel Signaling	VF Results
P/S TRAFFIC CHANNEL AB	P/S VF LEVEL
P/S TRAFFIC CHANNEL ABCD	P/S VF FREQ
P/S TRAFFIC TIMESLOT AB	P/S DATA BITS
	DTMF SEQ
	P/S TS CH

TIME Category — Lists results for time of day, date, and signal loss seconds.

TIME
DATE
P/S SIG L SEC

4.21 DLC ANALYZER OPTION — TROUBLESHOOTING CONTROLS

During circuit testing, it is often necessary to control the channel signaling bit status of the individual channels. Figure 4-9 illustrates the following **SIGNALING INSERT** switches used to control channel signaling.

- **ABCD** switches (22)
- **ON HOOK** switch (23)
- **RING** switch (24)
- **OFF HOOK** switch (25)

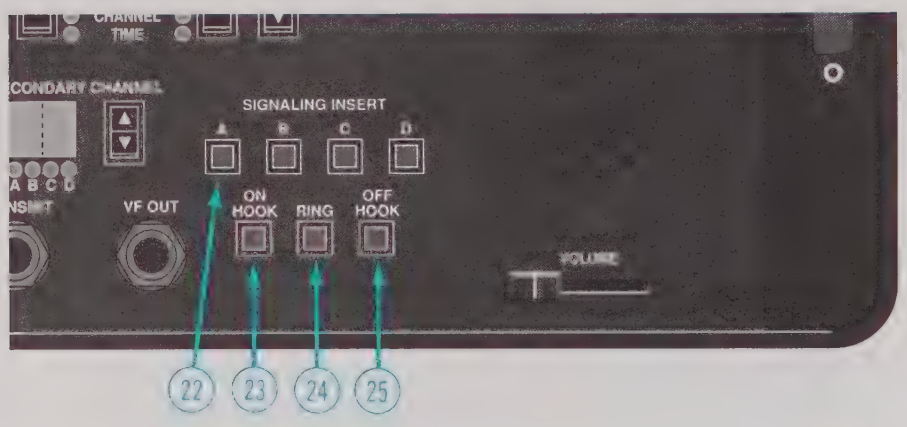


Figure 4-9
Signaling Insert Controls and Indicators

SIGNALING INSERT Switches

Seven switches are provided to insert signaling information into the selected channel or timeslot. The selected channel or timeslot appears in the SECONDARY CHANNEL window. When the CHANNEL format is selected and the **INSERT** switch is illuminated, the signaling bits are inserted over the signaling bits being received on the selected DS0 channel. Table 4-9 provides the signaling bit patterns that can be used to control D4, D1D, and SLC channel banks. Table 4-10 provides the signaling bit patterns that can be used to control T1 ESF channel banks. When the secondary channel number is changed and the **INSERT** switch is illuminated, the **SIGNALING INSERT** switches are temporarily inhibited until the **INSERT** switch stops flashing.

The T-BERD DLC Analyzer generates on- and off-hook signaling states that emulate the station end of the circuit and assumes the far end is sending office supervision. The ringing signaling state emulates the office signaling.

When the format is toggled between CHANNEL and DATLINK, the **SIGNALING INSERT** switch settings are stored in memory. When the **FORMAT** switch is set to DATLINK, the signaling is passed through the T-BERD DLC Analyzer unaffected. The **AB** switches are functional in all frame modes. The **CD** switches are only functional in the T1 ESF mode. The **ON HOOK**, **OFF HOOK**, and **RING** switches are not functional in the SLC-M2 mode.

Table 4-9
D1D and SLC Framed Signaling States

Signaling State	A	B
On-hook	0	0
Off-hook	1	0
Ringing	1	1/0

Table 4-10
T1 ESF Signaling States

Direction	Signaling State	A	B	C	D
Ground Start Signaling					
Transmit	On-hook	0	0	0	0
	Ringing	1	1	1	0
	Off-hook	1	0	1	0
Receive	On-hook	0	0	0	0
	Off-hook	0	1	0	0
Loop Start Signaling					
Transmit	On-hook	0	0	0	0
	Off-hook	1	0	1	0
Receive	On-hook	1	1	1	1
	Ringing	1	1	1	0
	Off-hook	1	1	1	1

ABCD Switches (22)

The individual signaling bits can be set using the **ABCD** switches. The signaling bits can be set to a logic 0, 1, or toggled 0/1 in the following manner.

- To insert a logic 1, press the switch for less than one second; the switch LED illuminates and the logic 1 is inserted into the appropriate bit location when the **INSERT** switch is illuminated.

- To insert a logic 0, press the switch for less than one second; the switch LED goes out and the logic 0 is inserted into the appropriate bit location when the **INSERT** switch is illuminated.

- To toggle the bit location between a logic 1 and 0, press the switch for more than one second; the switch LED flashes and the toggled bits are inserted into the appropriate bit location when the **INSERT** switch is illuminated. The toggling state is stopped by pressing the switch again.

If the **ABCD** switches are all illuminated in the T1 ESF mode and another mode is selected, the **CD** switches are turned off. When an on-hook, off-hook, or ring signaling state is set with the **ABCD** switches, the **ON HOOK, OFF HOOK,** or **RING** switch LED illuminates indicating the signaling state. The **ABCD** switch LEDs also illuminate when the **ON HOOK, OFF HOOK,** or **RING** switches are used. Only one of these signaling conditions can be activated at one time with the **ABCD** switches or one of the following switches.

ON HOOK Switch (23)

Press this switch to send an on-hook state. The transmitted bit pattern is determined by the TRUNK TYPE auxiliary function and the framing. When the **ON HOOK** switch is pressed, the **ABCD** switches are updated to reflect the on-hook state. This switch is not functional in the SLC-M2 mode.

RING Switch (24)

Press this switch to send a ringing state. The transmitted bit pattern is determined by the TRUNK TYPE auxiliary function and the framing. When the **RING** switch is pressed, the **ABCD** switches are updated to reflect the ringing state. This switch is not functional in the SLC-M2 mode.

OFF HOOK Switch (25)

Press this switch to send an off-hook state. The transmitted bit pattern is determined by the TRUNK TYPE auxiliary function and the framing. When the **OFF HOOK** switch is pressed, the **ABCD** switches are updated to reflect the off-hook state. This switch is not functional in the SLC-M2 mode.

4.22 DLC ANALYZER OPTION — PRINTER CONTROL

The **PRINT** switch and the RS-232 interface are for future enhancements. If the **PRINT** switch is pressed, the message *OPTION NOT INSTALLED* flashes in the RESULTS I window.

SECTION 5
AUXILIARY FUNCTIONS

AUXILIARY FUNCTIONS

5.1 INTRODUCTION

This section describes the auxiliary functions for the T-BERD 209A mainframe and the T-BERD DLC Analyzer Option. Auxiliary functions allow access to selectable functions and parameters that are less frequently used and do not have dedicated switches.

5.2 MAINFRAME — AUXILIARY FUNCTIONS

The mainframe auxiliary functions are selected using the **MODE** switch. Press the **MODE** switch once from an operating mode (e.g., T1 D4), to select the AUX mode. When the AUX mode appears, the auxiliary functions are selected by pressing the **PATTERN** switch.

Table 5-1 lists the auxiliary functions by mainframe and option. The auxiliary functions are described in factory-default order.

Table 5-1
T-BERD 209A Auxiliary Functions

Auxiliary Function	Description
Mainframe	
AUX USER1	User 1 Programmable Test Pattern
AUX USER2	User 2 Programmable Test Pattern
AUX RESPONSE	Loop Code Response Function
AUX PGM LPUP	Programmable Loop-up Code
AUX PGM LPDN	Programmable Loop-down Code
AUX BAUD	RS-232 Printer/Remote Control Baud Rate Select
AUX PARITY	RS-232 Printer/Remote Control Parity Select
AUX HALT/CONT	Action on Pattern Synchronization Loss
AUX PRNT FMT	Results Printout Format
AUX TERM	RS-232 Printer/Remote Control Line Terminator
AUX PLS MASK	Pulse Shape Measurement Mask Select
AUX RES HIST	Results History Buffer
AUX HIST CLR	Clear History and Printer Buffers

Table 5-1
T-BERD 209A Auxiliary Functions (Continued)

Auxiliary Function	Description
Mainframe	
AUX ERR SEL	BPV and Logic Error Burst Duration Select
AUX FRM ERR	Frame Error Insertion Select
AUX ER RATE	BPV and Logic Error Insertion Rate
AUX CLOCK	Set Clock Time
AUX DATE	Set Date
AUX TEST LEN	Set Timed Test Length Duration
AUX GRAPH	Print Graph Function
AUX LP CODE	Loop Code Select
AUX ESF LOOP	ESF Loop Code Select
Battery Option	
AUX PWR	Battery Power Save Control
Advanced BERT Option	
AUX LUP	Programmable Long User Pattern
Fractional T1 Option	
AUX FT1 CHAN	Fractional T1 Channel Bandwidth
AUX FT1 SETUP	FT1 Idle Code and Channel Rate
Enhanced ESF Option	
AUX PRM	Performance Report Message Control

AUX USER1 — User 1 Programmable Test Pattern

The AUX USER1 function enables a 3- to 24-bit user-programmable test pattern to be entered. This allows the T-BERD 209A to transmit specific bit patterns to test circuit sensitivity to the pattern.

FORWARD — Press the **RESULTS I Results** switch up arrow to move the cursor FORWARD from left to right. Moving the cursor (blinking bit) FORWARD past the last displayed bit automatically inserts a "0" in each new position up to 24 bits.

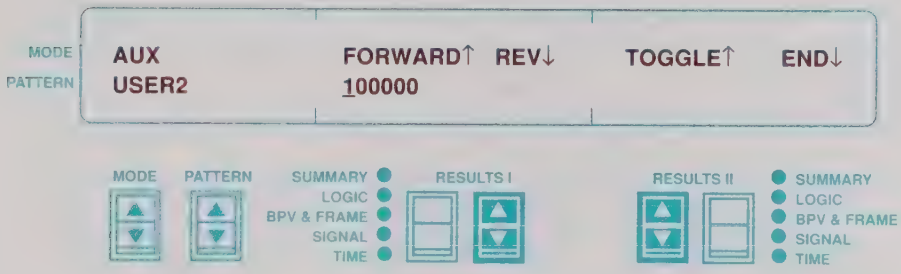
REV — Press the **RESULTS I Results** switch down arrow to move the cursor in REVerse from right to left.

TOGGLE — Press the **RESULTS II Results** switch up arrow to TOGGLE the bit between "1" and "0" at the cursor.

END — Press the **RESULTS II Results** switch down arrow to END or save the bit pattern from the position of the cursor to the first bit on the left. Any bits to the right of the cursor are deleted when the switch is pressed.

The pattern is generated when USER1 is selected with the **PATTERN** switch and an operating mode is displayed. The pattern is transmitted from left to right as its displayed. A test restart only occurs when the pattern is saved and being transmitted at the same time.

AUX USER2 — User 2 Programmable Test Pattern



The AUX USER2 function enables a 3- to 24-bit user-programmable test pattern to be entered. This allows the T-BERD 209A to transmit specific bit patterns to test circuit sensitivity to the pattern.

FORWARD — Press the **RESULTS I Results** switch up arrow to move the cursor FORWARD from left to right. Moving the cursor (blinking bit) FORWARD past the last displayed bit automatically inserts a "0" in each new position up to 24 bits.

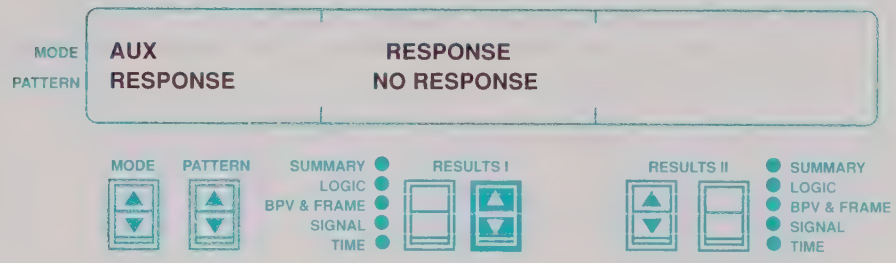
REV — Press the **RESULTS I Results** switch down arrow to move the cursor in REVerse from right to left.

TOGGLE — Press the **RESULTS II Results** switch up arrow to TOGGLE the bit between "1" and "0" at the cursor.

END — Press the **RESULTS II Results** switch down arrow to END or save the bit pattern from the position of the cursor to the first bit on the left. Any bits to the right of the cursor are deleted when the switch is pressed.

The pattern is generated when USER2 is selected with the **PATTERN** switch and an operating mode is displayed. The pattern is transmitted from left to right as its displayed. A test restart only occurs when the pattern is saved and being transmitted at the same time.

AUX RESPONSE — Loop Code Response Function



The AUX RESPONSE function determines whether the T-BERD 209A enters automatic line loopback mode (AUTO LLB) in response to received loop codes.

RESPONSE — Press the **RESULTS I Results** switch to select one of the following:

NO RESPONSE — T-BERD 209A does not respond to received loop codes except to illuminate the Loop Up or Loop Down LED.

AUTO RESPONSE — T-BERD 209A automatically responds to received loop codes by enabling or disabling the AUTO LLB mode. The instrument only responds to loop codes matching the loop code selected from the AUX LP CODE and AUX ESF LOOP functions.

In AUTO RESPONSE mode, T-BERD 209A enables AUTO LLB after receiving 5 seconds of in-band loop-up code or after receiving 250 ms of ESF out-of-band loop-up code. The T-BERD 209A emulates a CSU in loopback. AUTO LLB functions the same as the T1 LLB operating mode which is entered manually from the front panel.

If the T-BERD 209A is set to T1 TLB, T1 LLB, or T1C TLB mode, the T-BERD 209A does not respond to the received loop codes except to illuminate the Loop Up or Loop Down LED. AUTO LLB is disabled after receiving the in-band or ESF out-of-band loop-down code. When disabled, the instrument also returns to the previously selected operating mode.

When operating in the FT1 modes (FT1 D4, FT1 ESF, or FT1 ESFz) and AUTO RESPONSE is selected, the T-BERD 209A does not respond to in-band loop codes. However, the T-BERD 209A does respond to ESF out-of-band loop codes when the T-BERD 209A is configured for T1 ESF, T1 ESFz, FT1 ESF, or FT1 ESFz operation. It should also be noted that the AUTO RESPONSE mode establishes a full bandwidth loopback and bit error rate test.

Consider the following functions when changing AUX RESPONSE:

- AUX LP CODE (select loop code type)
- AUX ESF LOOP (select ESF loop code type)
- Loop Code LEDs

AUX PGM LPUP — Programmable Loop-up Code

The AUX PGM LPUP function enables a 3- to 8-bit user-programmable loop-up code to be entered. This allows the T-BERD 209A to transmit and respond to nonstandard loop codes.

FORWARD — Press the **RESULTS I Results** switch up arrow to move the cursor FORWARD from left to right. Moving the cursor (blinking bit) FORWARD past the last displayed bit automatically inserts a "0" in each new position up to eight bits.

REV — Press the **RESULTS I Results** switch down arrow to move the cursor in REVerse from right to left.

TOGGLE — Press the **RESULTS II Results** switch up arrow to TOGGLE the bit between "1" and "0" at the cursor.

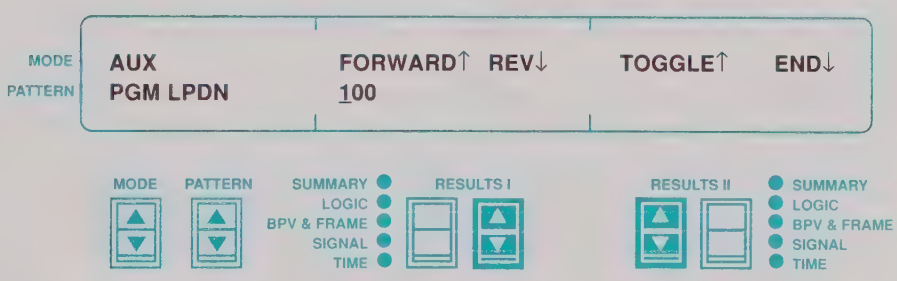
END — Press the **RESULTS II Results** switch down arrow to END or save the bit pattern from the position of the cursor to the first bit on the left. Any bits to the right of the cursor are deleted when the switch is pressed.

A loop-up code is generated when the **LOOP CODE LOOP UP** switch is pressed and PGM is selected in the AUX LP CODE function. The loop code is transmitted from left to right as displayed.

Consider the following functions and modes when changing AUX PGM LPUP:

- LOOP CODE Control
- AUX LP CODE
- AUX ESF LOOP
- AUX PGM LPDN
- AUX RESPONSE

AUX PGM LPDN — Programmable Loop-down Code



The AUX PGM LPDN function enables a 3- to 8-bit user-programmable loop-down code to be entered. This allows the T-BERD 209A to transmit and respond to nonstandard loop codes.

FORWARD — Press the **RESULTS I Results** switch up arrow to move the cursor FORWARD from left to right. Moving the cursor (blinking bit) FORWARD past the last displayed bit automatically inserts a "0" in each new position up to eight bits.

REV — Press the **RESULTS I Results** switch down arrow to move the cursor in REVerse from right to left.

TOGGLE — Press the **RESULTS II Results** switch up arrow to TOGGLE the bit between "1" and "0" at the cursor.

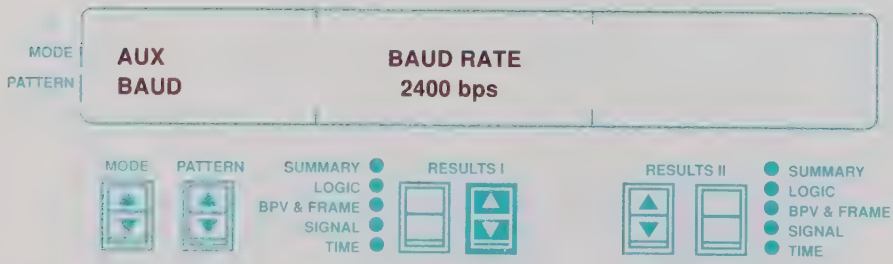
END — Press the **RESULTS II Results** switch down arrow to END or save the bit pattern from the position of the cursor to the first bit on the left. Any bits to the right of the cursor are deleted when the switch is pressed.

A loop-down code is generated when the **LOOP CODE LOOP DOWN** switch is pressed and PGM is selected in the AUX LP CODE function. The loop code is transmitted from left to right as displayed.

Consider the following functions and modes when changing AUX PGM LPDN:

- LOOP CODE Control
- AUX LP CODE
- AUX ESF LOOP
- AUX PGM LPUP
- AUX RESPONSE

AUX BAUD — RS-232 Printer/Remote Control Baud Rate Select



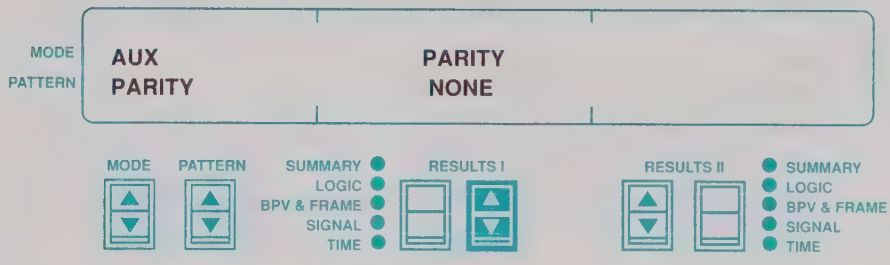
The AUX BAUD function selects the baud rate for the RS-232 Printer/Remote Control interface.

BAUD RATE — Press the **RESULTS I Results** switch to select one of the following baud rates: 300 bps, 1200 bps, 2400 bps, and 4800 bps.

Consider the following functions and modes when changing AUX BAUD:

- AUX PARITY
- AUX TERM
- RS-232-C Printer/Remote Control Interface
- Printer and remote control operation

AUX PARITY — RS-232 Printer/Remote Control Parity Select



The AUX PARITY function selects the parity for the RS-232 Printer/Remote Control interface connector.

PARITY — Press the **RESULTS I Results** switch to select one of the following parity modes:

NONE — Disables parity but configures the data output for eight data bits. Parity must be set to NONE to print the pulse shape graph; graphics printers require eight data bits.

EVEN — Enables EVEN parity but configures the data output for seven data bits.

ODD — Enables ODD parity but configures the data output for seven data bits.

Consider the following functions and modes when changing AUX PARITY:

- AUX TERM
- AUX BAUD
- RS-232-C Printer/Remote Control Interface
- Printer and remote control operation

AUX HALT/CONT — Action on Pattern Synchronization Loss

The AUX HALT/CONT function determines how the LOGIC category results are accumulated during pattern synchronization loss. Changing AUX HALT/CONT during a test, restarts the test.

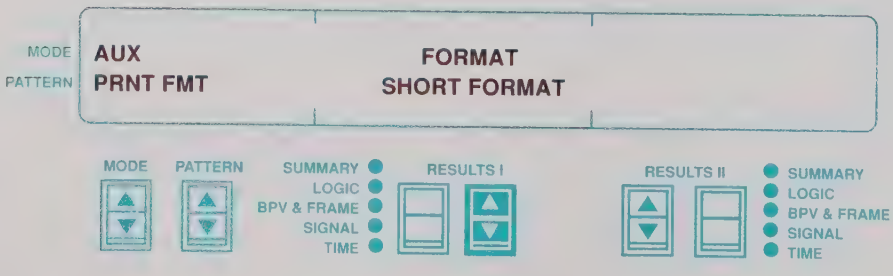
HALT/CONTINU — Press the **RESULTS I Results** switch to select one of the following conditions:

HALT — Freezes all LOGIC category results when pattern synchronization is lost; the results resume counting when synchronization is reacquired.

CONTINUOUS — Error and slip counts continue throughout synchronization loss.

NOTE. When any Advanced BERT Option test pattern is selected, the instrument defaults to the HALT mode.

AUX PRNT FMT — Results Printout Format



The AUX PRNT FMT function selects the results printout format transmitted through the RS-232 Printer/Remote Control interface.

FORMAT — Press the **RESULTS I Results** switch to select one of the following:

SHORT FORMAT — Results printout lists a standard set of results with additional results that are mode specific.

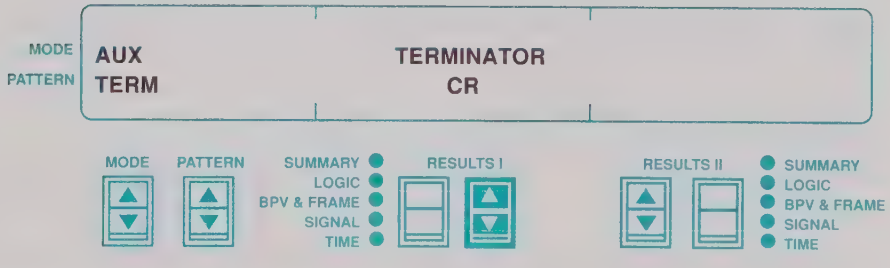
SUMMARY PRINT — Results printout lists SUMMARY category results.

NORMAL FORMAT — Results printout lists all test results.

Consider the following functions and modes when changing AUX PRNT FMT:

- RS-232-C Printer/Remote Control Interface
- Printer and remote control operation

AUX TERM — RS-232 Printer/Remote Control Line Terminator



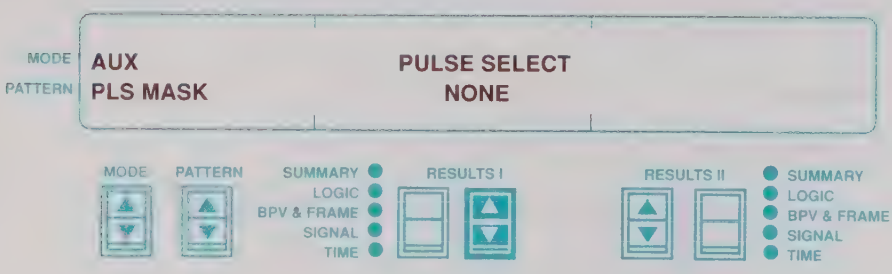
The AUX TERM function selects the line termination character transmitted through the RS-232 Printer/Remote Control interface.

TERMINATOR — Press the **RESULTS I Results** switch to select either CR (carriage return) or CRLF (carriage return/linefeed).

Consider the following functions and modes when changing AUX TERM:

- AUX PARITY
- AUX BAUD
- RS-232-C Printer/Remote Control Interface
- Printer and remote control operation

AUX PLS MASK — Pulse Shape Measurement Mask Select



The AUX PLS MASK function selects the standard pulse shape mask used to evaluate the received pulses.

PULSE SELECT — Press the **RESULTS I Results** switch to select one of the following:

***NONE* —** The pulse shape is not evaluated against pulse mask specifications, however, the pulse shape measurements are still made. When NONE is selected, the Pulse Shape LED is disabled, no mask appears on the pulse shape printout, and the message *NO MASK* appears in the 44-PULSE SHAPE result.

***NI (ANSI)* —** The pulse shape is evaluated against the ANSI T1.403 Network Interface pulse mask specification.

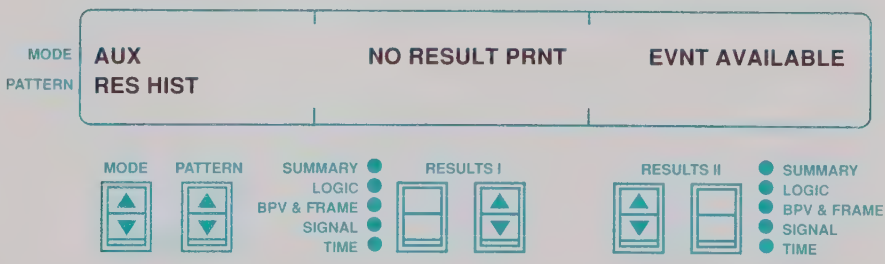
***DSX (CB119)* —** The pulse shape is evaluated against the AT&T Compatibility Bulletin 119 and ANSI T1.102 pulse mask specifications.

When a mask is selected, the Pulse Shape LED illuminates when the pulse shape violates the mask. Changing AUX PLS MASK during a test restarts the test. If a mask is selected, the message *PASS, FAIL, OUT OF RANGE*, or *UNAVAILABLE* can appear in the 44-PULSE SHAPE result.

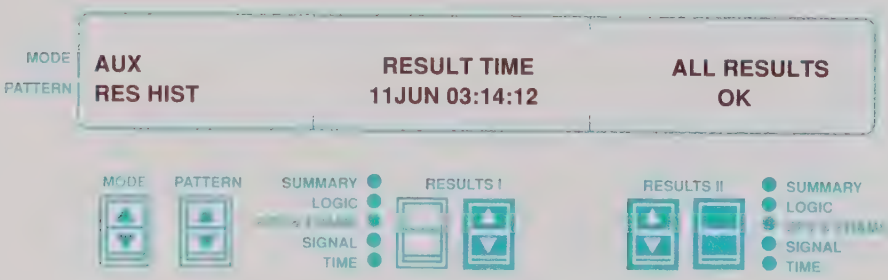
Consider the following SIGNAL category results and functions when changing AUX PLS MASK:

- 44-PULSE SHAPE
- 45-PULSE WIDTH
- 46-RISE TIME
- 47-FALL TIME
- 48-UNDERSHOOT
- 49-OVERSHOOT
- AUX GRAPH
- Graphic printer operation

AUX RES HIST — Results History Buffer



The AUX RES HIST function allows the most recent results generated to be reviewed from the front panel. When the message *NO RESULT PRNT EVNT AVAILABLE* (no result print event available) appears, the **RESULTS** switches are not functional and no results are stored in memory. However, if for example the history buffer contains stored results, the following appears:



The AUX RES HIST function provides access to six sets of the most recent test results generated when a print event occurs or the **PRINT RESULTS** switch is pressed. The oldest result is dropped when a new result is stored.

RESULT TIME — Press the **RESULTS I Results** switch to scroll through the time-stamped RESULT TIME list displayed in the RESULTS I window.

Press the **RESULTS I Results** switch up arrow to scroll to the most recent result. The message *MOST RECENT RESULTS* flashes in the RESULTS I window when the **RESULTS I Results** switch up arrow is pressed to scroll past the most recent result.

Press the **RESULTS I Results** switch down arrow to scroll to the earliest result saved. The message *EARLIEST SAVED RESULTS* flashes in the RESULTS I window when the **RESULTS I Results** switch down arrow is pressed to scroll past the earliest saved result.

Test Results — Press the **RESULTS II** switches to scroll through the test results displayed in the RESULTS II window.

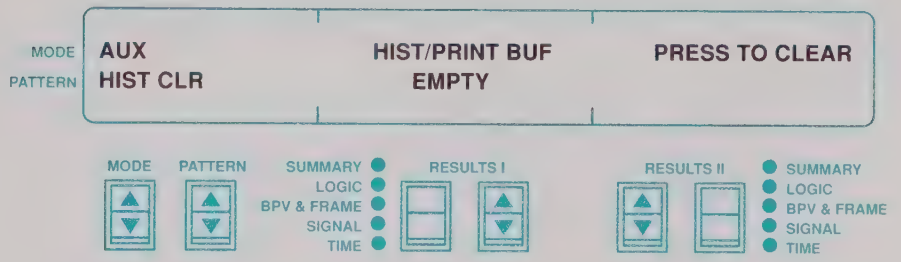
Press the **RESULTS II Category** switch to select the desired category.

Press the **RESULTS II Results** switch to scroll through all results in the selected category.

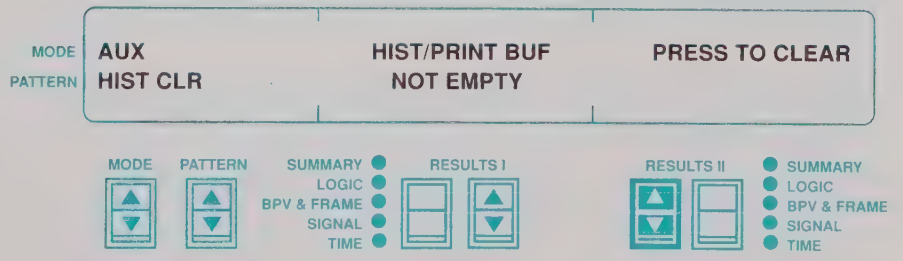
Consider the following functions when changing AUX RES HIST:

- AUX HIST CLR function
- **PRINT EVENT** and **PRINT** switches

AUX HIST CLR — Clear History and Printer Buffers



The AUX HIST CLR function clears the History and Print buffers. When the message *HIST/PRINT BUF EMPTY* appears, the **RESULTS** switches are not functional and no results are stored in memory. However, if results are stored in either the results history buffer or printer buffer, the following appears:

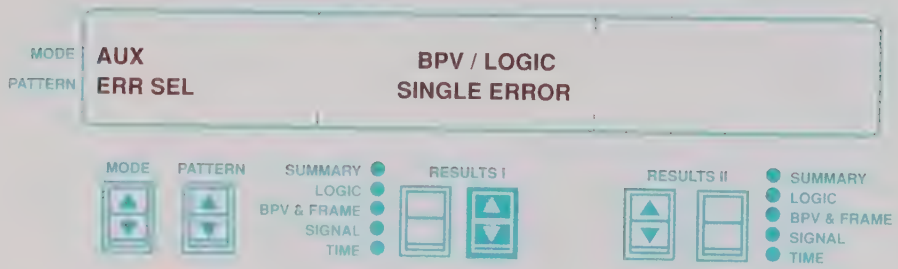


When the buffers have stored results, the message *HIST/PRINT BUF NOT EMPTY* appears in the RESULTS I window. To clear the buffers, press the **RESULTS II Results** switch; the message *HIST/PRINT BUF EMPTY* appears in the RESULTS I window when the buffers are empty.

Consider the following functions when using AUX HIST CLR:

- AUX RES HIST function
- Printer operation

AUX ERR SEL — BPV and Logic Error Burst Duration Select



The AUX ERR SEL function selects the duration for the BPV and logic error bursts when the **BPV** and **LOGIC ERROR INSERT** switches are pressed once.

BPV/LOGIC — Press the **RESULTS I Results** switch to select one of the following:

SINGLE ERROR — Inserts a single BPV or LOGIC error when the appropriate switch is pressed once.

5.0 sec Burst to 1.5 sec Burst (in 0.5 sec Steps) — Inserts a BPV or logic error burst from 1.5 seconds to 5.0 seconds when the appropriate switch is pressed once.

1.5 sec Burst to 1.0 sec Burst (in 0.1 sec Steps) — Inserts a BPV or logic error burst from 1.0 seconds to 1.5 seconds when the appropriate switch is pressed once.

900 ms Burst to 500 ms Burst (in 100 ms Steps) — Inserts a BPV or logic error burst from 500 milliseconds to 900 milliseconds when the appropriate switch is pressed once.

500 ms Burst to 200 ms Burst (in 50 ms Steps) — Inserts a BPV or logic error burst from 200 milliseconds to 500 milliseconds when the appropriate switch is pressed once.

200 ms Burst to 25 ms Burst (in 25 ms Steps) — Inserts a BPV or logic error burst from 25 milliseconds to 200 milliseconds when the appropriate switch is pressed once.

NOTE When testing FT1 circuits (FT1 D4, FT1 ESF, or FT1 ESFz modes), a single error is only inserted in the selected FT1 bandwidth. The burst, consecutive, and continuous error insertion is applied to the entire T1 bandwidth.

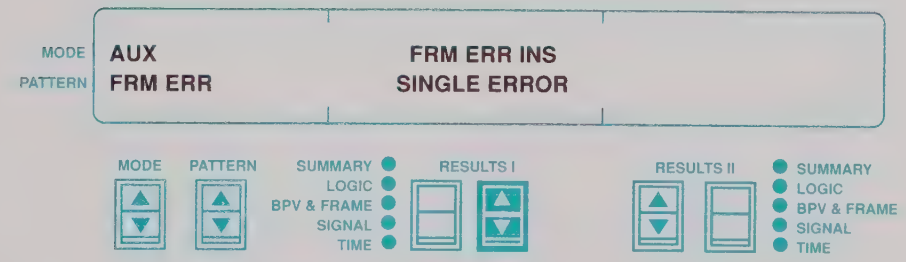
The error rate during the burst is controlled through the AUX ER RATE function. Changing AUX ERR SEL immediately changes the burst duration but does not restart the test.

NOTE: When the **ERROR INSERT** switches are pressed, held, and illuminate, errors are inserted continuously at the error rate selected from the AUX ER RATE function.

Consider the following functions when using AUX ERR SEL:

- **BPV** and **LOGIC ERROR INSERT** switches
- AUX ER RATE function

AUX FRM ERR — Frame Error Insertion Select



The AUX FRM ERR function selects the number of consecutive frame errors inserted into the framing format when the **FRAME ERROR INSERT** switch is pressed once.

FRM ERR INS — Press the **RESULTS I Results** switch to select one of the following:

SINGLE ERROR — Inserts a single frame error.

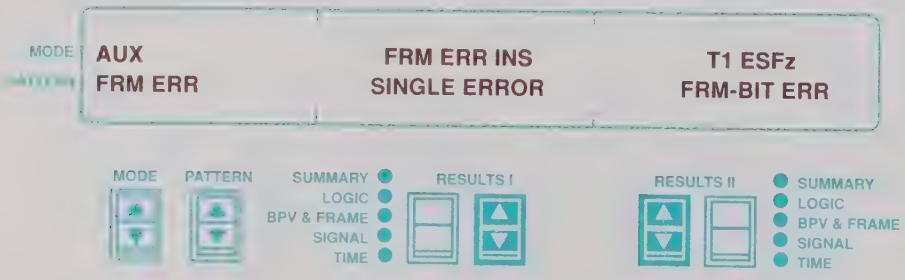
2 to 6 CONSECUTIVE — Inserts 2 to 6 consecutive frame errors.

When the **FRAME ERROR INSERT** switch is pressed, held, and illuminates, the number of selected frame errors are inserted into the superframe or extended superframe format. AUX FRM ERR is only functional in framed operating modes (e.g., T1 D4, T1 ESF, T1 ESFz, and T1 SLC).

Consider the following BPV & FRAME category results and functions when changing AUX FRM ERR:

- **MODE** (framed modes) switch
- **FRAME ERROR INSERT** switch
- 28-FRM ERR SEC
- 29-FRAME SES
- 30-FRM ERRORS
- 31-FRM ER RATE
- 34-FRM LOS CNT
- 35-FRM LOS SEC

When the Enhanced ESF Option is installed to test ESFz circuits, the frame error can be inserted on the F-bit or Z-bit through the AUX FRM ERR, T1 ESFz, function as follows:



The AUX FRM ERR, T1 ESFz, function selects where the frame errors are inserted in ESFz framed signals when the **FRAME ERROR INSERT** switch is pressed.

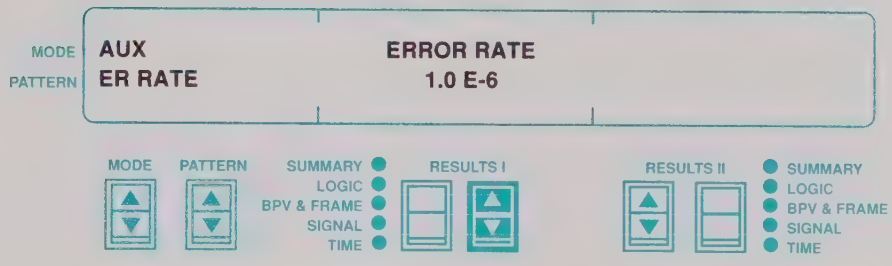
T1 ESFz — Press the **RESULTS II Results** switch to select the placement of the framing error:

FRM-BIT ERR — Inserts frame errors on the Frame Alignment Signal bit.

Z-BIT ERR — Inserts frame errors on the Z-bit of a ZBTSI encoded ESF formatted signal.

The AUX FRM ERR, FRM ERR INS, still controls the number of frame errors inserted. The AUX FRM ERR, T1 ESFz, does not affect the other framing formats.

AUX ER RATE — BPV and Logic Error Insertion Rate



The AUX ER RATE function selects the BPV and LOGIC error insertion rate when a burst of errors is inserted or when continuous errors are inserted.

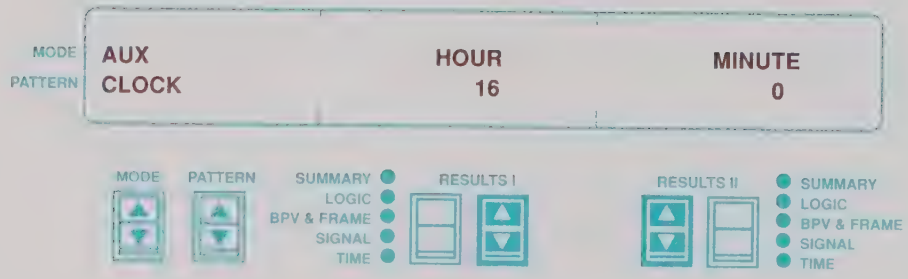
ERROR RATE — Press the **RESULTS I Results** switch to select an error rate from 1.0 E-2 to 9.9 E-9. Changing the error rate does not restart the test. The displayed error rates are interpreted as follows:

1.0 E-2 = 0.01 = 1 bit error in a 100 bits sent.
1.0 E-3 = 0.001 = 1 bit error in a 1000 bits sent.
1.0 E-4 = 0.0001 = 1 bit error in a 10,000 bits sent.
1.0 E-5 = 0.00001 = 1 bit error in a 100,000 bits sent.
1.0 E-6 = 0.000001 = 1 bit error in a 1 million bits sent.
1.0 E-7 = 0.0000001 = 1 bit error in a 10 million bits sent.
1.0 E-8 = 0.00000001 = 1 bit error in a 100 million bits sent.
1.0 E-9 = 0.000000001 = 1 bit error in a 1 billion bits sent.

Consider the following functions when changing AUX ERR INS:

- AUX ERR SEL function
- **BPV** and **LOGIC ERROR INSERT** switches

AUX CLOCK — Set Clock Time



The AUX CLOCK function sets the time (in 24-hour format) for the battery-backed clock.

HOUR — Press the **RESULTS I Results** switch to set the current hour from 0 to 23 hours.

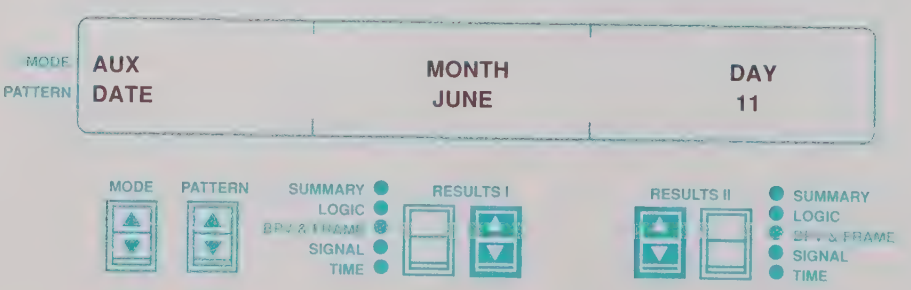
MINUTE — Press the **RESULTS II Results** switch to set the current minutes from 0 to 59 minutes.

The clock time appears on all printouts generated by the T-BERD 209A. The current time appears in the TIME category, 65-CLOCK TIME result.

Consider the following functions when changing AUX CLOCK:

- AUX DATE function
- Printer operation

AUX DATE — Set Date



The AUX DATE function sets the month and day for the battery-backed clock.

MONTH — Press the **RESULTS I Results** switch to set the current month from January to December.

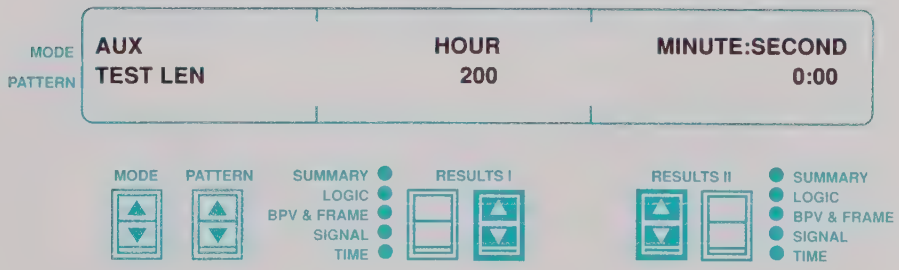
DAY — Press the **RESULTS II Results** switch to set the current day of the month from 1 to 31.

The month and day appear on all printouts generated by the T-BERD 209A. The current month and day appear in the TIME category, 66-DATE result.

Consider the following functions when changing AUX DATE:

- AUX CLOCK function
- Printer operation

AUX TEST LEN — Set Timed Test Length Duration



The AUX TEST LEN function sets the length of time for a timed test. The timed test is selected with the **TEST** switch.

HOUR — Press the **RESULTS I Results** switch to set the test length hours from 0 to 200 hours in 1 hour steps.

MINUTE:SECOND — Press the **RESULTS II Results** switch to set the test length minutes and seconds from 0:00 to 1:00 minute in 15 second steps (with 0 hours displayed) and 1:00 to 59:00 minutes in 1 minute steps (with 1 or more hours displayed).

When TIMED TEST is selected with the **TEST** switch, AUX TEST LEN is enabled and the test is restarted.

Consider the following functions and TIME category results when changing AUX TEST LEN:

- **TEST** switch
- **RESTART** switch
- 62-TEST LENGTH
- 63-ELAPSE TIME
- 64-TEST END IN

AUX PWR SAVE — Battery Power Save Control

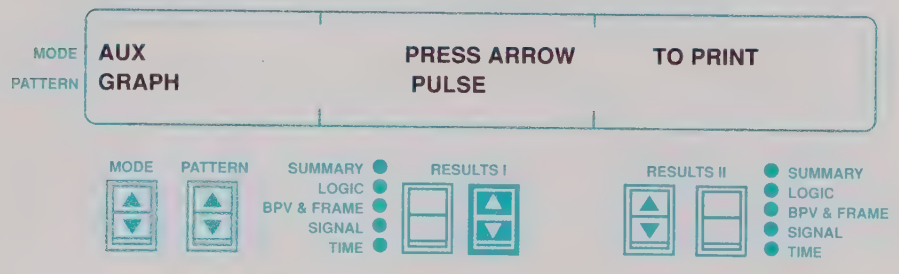
The AUX PWR SAVE function is used to prolong the battery charge by temporarily turning the display off when none of the switches have been pressed in over five minutes. This function can extend the battery charge up to 25% over normal use. It can also be used when AC power is applied.

POWER SAVE — Press the **RESULTS I Results** switch to turn the power saver on and off.

The T-BERD 209A continues to perform the current test even with the display turned off. To restore the display, press any switch once; this does not affect the switch setting.

When operating in the TDR mode with the power saver enabled and the display turned off, the **DISPLAY HOLD** switch LED illuminates indicating the instrument is in the power save mode.

AUX GRAPH — Print Graph Function



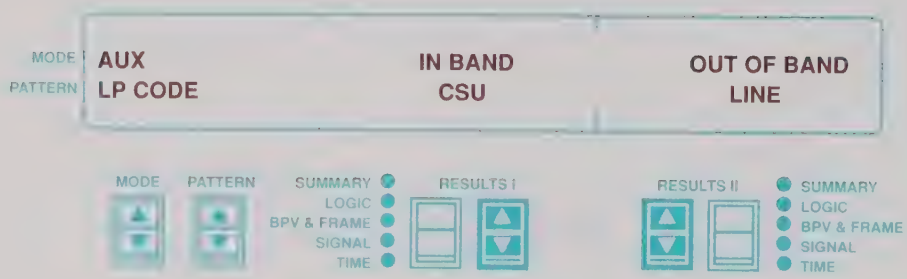
PULSE — The AUX GRAPH function initiates a pulse shape printout when the **RESULTS I Results** switch is pressed.

The pulse shape graph can only be generated on a graphics-compatible printer like the TTC PR-40A. The normalized amplitude pulse, related pulse shape results, and selected pulse shape mask appear on the printout. If the message *OUT OF RANGE* appears in the related results, printing the pulse shape graph causes the message *PULSE DATA NOT AVAILABLE* to be printed.

Consider the following functions, modes, and SIGNAL category results when printing a pulse shape graph:

- AUX PLS MASK
- Printer Operation
- 44-PULSE SHAPE (NO MASK/FAIL/PASS/OUT OF RANGE)
- 45-PULSE WIDTH (ns)
- 46-RISE TIME (ns)
- 47-FALL TIME (ns)
- 48-UNDERSHOOT (%)
- 49-OVERSHOOT (%)

AUX LP CODE — Loop Code Select



The AUX LP CODE function selects the loop code (in-band or ESF out-of-band) transmitted when the **LOOP CODE** switches are pressed. These selections also determine which loop code cause the T-BERD 209A to establish the AUTO LLB mode.

When the T1 ESF, T1 ESFz, FT1 ESF, and FT1 ESFz modes are selected, the in-band and ESF out-of-band loop code types are selected from the AUX ESF LOOP function.

Transmitting loop codes restarts the test. The loop code bit patterns shown in the following descriptions are transmitted in a left-to-right order.

IN BAND — In-band loop codes can be used in all operating modes. Press the **RESULTS I Results** switch to select one of the following in-band loop codes:

CSU — The Customer Service Unit loop codes allow the T-BERD 209A to establish a loopback with a compatible CSU or respond to a CSU loop code. CSU loop codes: loop up — 10000 and loop down — 100.

PGM — The 3- to 8-bit programmable loop codes allow the T-BERD 209A to establish a loopback with any nonstandard device or respond to a nonstandard loop code. The loop codes are programmed through the AUX PGM LPUP and AUX PGM LPDN functions.

FAC2 — The 5-bit facility or network (smart jack) loop codes allow the T-BERD 209A to establish a loopback with a compatible facility interface or respond to a facility loop code. 5-bit Facility loop codes: loop up — 11000 and loop down — 11100.

FAC1 — The 4-bit facility or network (smart jack) loop codes allow the T-BERD 209A to establish a loopback with a compatible facility interface or respond to a facility loop code. 4-bit Facility loop codes: loop up — 1100 and loop down — 1110.

OUT OF BAND — Out-of-band loop codes only apply to T1 ESF, T1 ESFz, FT1 ESF, and FT1 ESFz operating modes. Press the **RESULTS II Results** switch to select one of the following ESF out-of-band loop codes:

***LINE* —** The line loop codes allow the T-BERD 209A to establish a loopback with a compatible terminal or respond to a line loop code. ESF out-of-band line loop codes: loop up — 1111 1111 0111 0000 and loop down — 1111 1111 0001 1100.

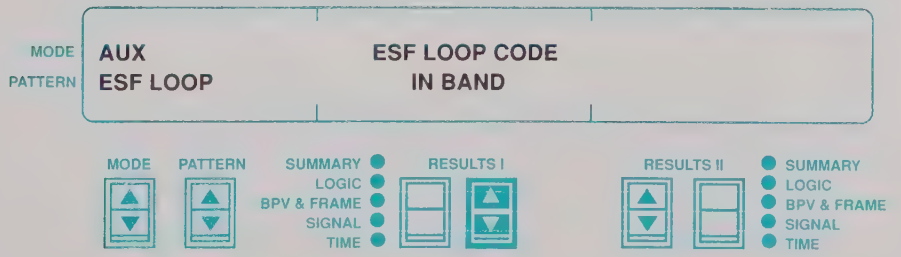
***PAYLOAD* —** The payload loop codes allow the T-BERD 209A to establish a loopback with a compatible terminal. However, the T-BERD 209A does not respond to payload loop codes. ESF out-of-band payload loop codes: loop up — 1111 1111 0010 1000 and loop down — 1111 1111 0100 1100.

***NETWORK* —** The network loop codes allow the T-BERD 209A to establish a loopback with a compatible terminal or respond to a network loop code. ESF out-of-band network loop codes: loop up — 1111 1111 0100 1000 and loop down — 1111 1111 0010 0100.

Consider the following functions and modes when sending and receiving loop codes:

- AUX ESF LOOP
- AUX PGM LPUP
- AUX PGM LPDN
- AUX RESPONSE
- **LOOP CODE** switches

AUX ESF LOOP — ESF Loop Code Select



The AUX ESF LOOP function selects the loop code type that is transmitted when the **LOOP CODE** switches are pressed.

This selection also determines which loop code type causes the T-BERD 209A to establish the AUTO LLB mode.

ESF LOOP CODE — Press the **RESULTS I Results** switch to select the method of transmitting the loop code in the following manner:

> ***IN BAND*** — The in-band loop codes (CSU, PGM, FAC1, and FAC2) are transmitted or responded to in place of the data or test pattern. When FT1 modes (Fractional T1 Option required) are selected, the T-BERD 209A only sends in-band loop codes within the selected FT1 channel bandwidth. However, the T-BERD 209A does not respond to FT1 in-band loop codes.
>
> ***OUT OF BAND*** — The out-of-band loop codes (LINE, PAYLOAD, and NETWORK) are transmitted or responded to over the ESF datalink.

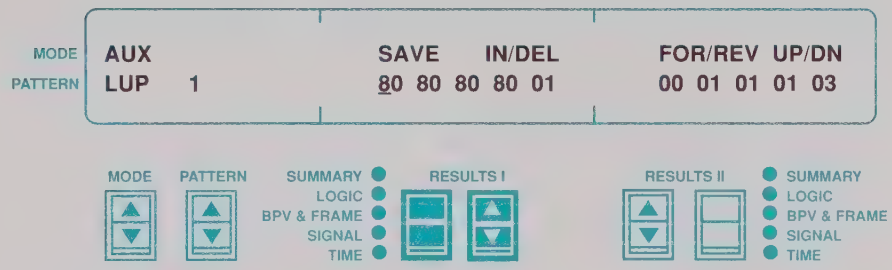
AUX ESF LOOP is only used when testing ESF, ESFz, FT1 ESF, or FT1 ESFz formatted circuits.

The specific loop code is selected from the AUX LP CODE function. Transmitting loop codes restarts the test even when the loop is not accomplished.

Consider the following functions and modes when sending and receiving loop codes:

- AUX LP CODE
- AUX PGM LPUP
- AUX PGM LPDN
- AUX RESPONSE
- **LOOP CODE** LEDs and switches

AUX LUP — Programmable Long User Pattern



The AUX LUP function enables a 1- to 2000-hexadecimal (byte) user-programmable test pattern to be entered. This allows the T-BERD 209A to transmit specific character patterns to test circuit sensitivity to the pattern.

Both sets of **RESULTS** switches are used to create or modify LUP.

SAVE — Press the **RESULTS I Category** switch to SAVE the current LUP and cursor position.

IN — Press the **RESULTS I Results** switch up arrow to INsert "00" (00 in hex) at the cursor position. Press the switch continuously to INsert "00" to the right of the cursor.

DEL — Press the **RESULTS I Results** switch down arrow to DELete the character at the cursor position. Press the switch continuously to DELete characters to the right of the cursor.

FOR — Press the **RESULTS II Results** switch up arrow to move the cursor FORward from left to right.

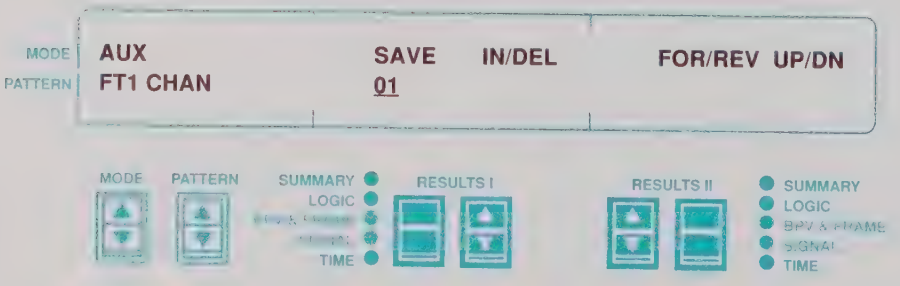
REV — Press the **RESULTS II Results** switch down arrow to move the cursor in REVerse from right to left. The cursor location appears in the PATTERN window (1 to 2000).

UP/DN — Press the **RESULTS II Category** switch to scroll the flashing digit UP or DowN to increment or decrement the digit from 0 to F in hexadecimal. Refer to Appendix C for a hexadecimal-to-binary conversion table.

The programmed test pattern is transmitted when LUP is selected with the **PATTERN** switch. A test restart occurs when LUP is being transmitted and the pattern is changed.

The pattern is entered in hexadecimal form. The pattern is transmitted starting from the LSB (Least Significant Bit) to the MSB (Most Significant Bit) of each hexadecimal character. *Example:* 74H = (MSB) 0111 0100 (LSB); transmitted in the following order: (LSB) 0010 1110 (MSB). A hexadecimal-to-binary conversion table can be found in Appendix C.

AUX FT1 CHAN — Set FT1 Channel Bandwidth



The AUX FT1 CHAN function selects the FT1 channel bandwidth being tested in FT1 circuits. The AUX function is only active in the FT1 operating modes (FT1 D4, FT1 ESF, and FT1 ESFz).

Both sets of **RESULTS** switches are used to create or modify the FT1 channel bandwidth.

SAVE — Press the **RESULTS I Category** switch to SAVE the current FT1 channels.

IN — Press the **RESULTS I Results** switch up arrow to INsert a channel number at the cursor position.

DEL — Press the **RESULTS I Results** switch down arrow to DELete the channel number at the cursor position. Press the switch to continuously DELete channel numbers to the right of the cursor. As each number is deleted, the number to the right takes the place of the deleted number. Channel numbers can be INserted between numbers that are not consecutive; a channel number cannot be INsert between consecutive numbers.

FOR — Press the **RESULTS II Results** switch up arrow to move the cursor FORward from left to right.

REV — Press the **RESULTS II Results** switch down arrow to move the cursor in REVerse from right to left.

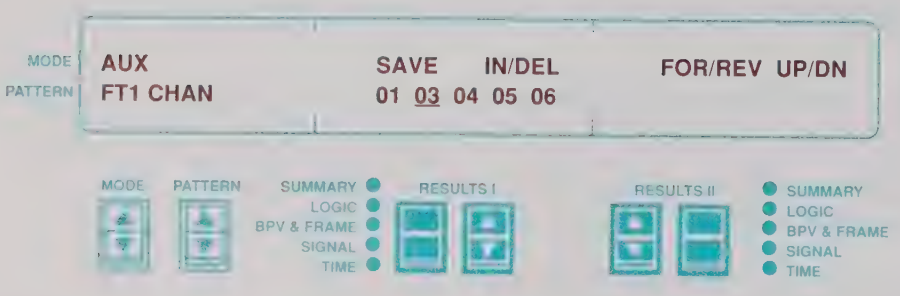
When the number of channels selected and displayed exceeds 10, the display acts as a window to the other channels. With the cursor positioned at either side of the display, press the **RESULTS II Results** switch to move the channel numbers past the display. It is possible to select all 24 channels. When the cursor moves past the last channel number to the right, the cursor becomes a flashing dash (— —). This allows a new channel number to be appended to the end of the current numbers; except when the last number is 24.

UP — Press the top part of the **RESULTS II Category** switch to scroll the flashing channel number UP from 01 to 24.

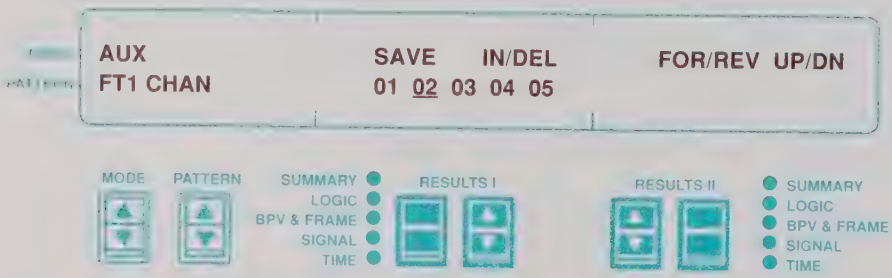
DN — Press the bottom part of the **RESULTS II Category** switch to scroll the flashing channel number down from 24 to 01.

The range of the channel numbers that can be scrolled is determined by the channel numbers on either side of the cursor. For example, if the cursor is positioned between channel numbers 05 and 15, the channel numbers that can be scrolled are between 06 and 14 inclusive.

When scrolling the channel number UP and DowN and not INserting channel numbers, all of the channel numbers to the right are incremented and decremented sequentially. For example, the channel numbers 01 to 05 are displayed and the cursor is placed at channel 02. Press the top part of the **RESULTS II Category** switch to increment channels 02, 03, 04, and 05 to 03, 04, 05, and 06, respectively.



Press the bottom part of the **RESULTS II Category** switch to decrement channels 03, 04, 05, and 06 to 02, 03, 04, and 05, respectively. The channel numbers cannot be decremented past channel 01.



The highest available channel number is 24; any channel forced to be greater than 24 is deleted. The channel numbers are indicated in logical order corresponding to the selected framing mode. Contiguous FT1 channels are entered in sequential order starting with the first DS0 channel and ending with the last DS0 channel of the FT1 channel. Table 5-2 lists the two available DS0 data rates, 64 kb/s and 56 kb/s, and the FT1 channel bandwidths, 64xN and 56xN (N = 1 to 24). "N" is the number of DS0 channels that make up the FT1 channel.

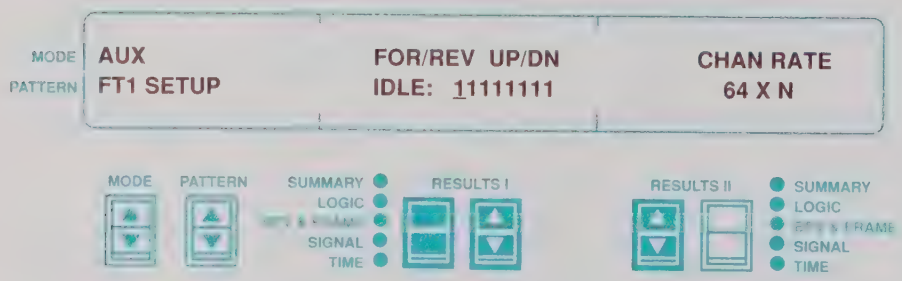
Table 5-2
Fractional T1 Bandwidths

64xN							
N	**Bandwidth**	**N**	**Bandwidth**	**N**	**Bandwidth**	**N**	**Bandwidth**
1	64 kHz	7	448 kHz	13	832 kHz	19	1216 kHz
2	128 kHz	8	512 kHz	14	896 kHz	20	1280 kHz
3	192 kHz	9	576 kHz	15	960 kHz	21	1344 kHz
4	256 kHz	10	640 kHz	16	1024 kHz	22	1408 kHz
5	320 kHz	11	704 kHz	17	1088 kHz	23	1472 kHz
6	384 kHz	12	768 kHz	18	1152 kHz	24	1536 kHz
56xN							
N	**Bandwidth**	**N**	**Bandwidth**	**N**	**Bandwidth**	**N**	**Bandwidth**
1	56 kHz	7	392 kHz	13	728 kHz	19	1064 kHz
2	112 kHz	8	448 kHz	14	784 kHz	20	1120 kHz
3	168 kHz	9	504 kHz	15	840 kHz	21	1176 kHz
4	224 kHz	10	560 kHz	16	896 kHz	22	1232 kHz
5	280 kHz	11	616 kHz	17	952 kHz	23	1288 kHz
6	336 kHz	12	672 kHz	18	1008 kHz	24	1344 kHz

Consider the following functions when changing AUX FT1 CHAN:

- AUX FT1 SETUP function
- FT1 operating modes

AUX FT1 SETUP — Set FT1 Idle Code and Channel Rate



The AUX FT1 SETUP function sets the FT1 idle code and channel rate. The AUX function is only active in the FT1 operating modes (FT1 D4, FT1 ESF, and FT1 ESFz).

FOR/REV — Press the **RESULTS I Category** switch to move the cursor FORward or REVerse in the idle code. The idle code is transmitted on those channels not selected from the AUX FT1 CHAN function. Bit 1 (the left-most bit) is transmitted first.

UP/DN — Press the **RESULTS I Results** switch to TOGGLE the selected bit to 0 or 1 in the idle code.

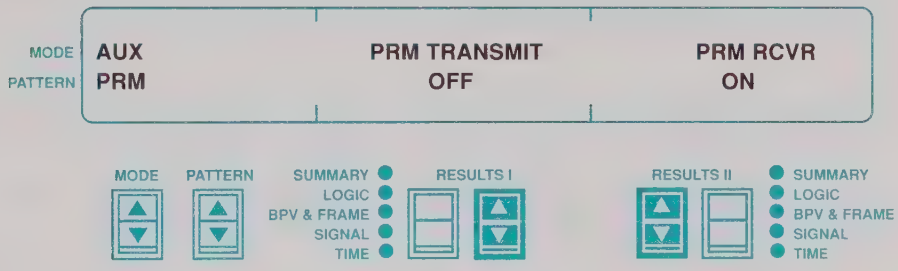
CHAN RATE — The channel rate determines the DS0 data rate. Press the **RESULTS II Results** switch to select either 56xN (56 kb/s DS0 data rate by "N" number of channels) or 64xN (64 kb/s DS0 data rate by "N" number of channels).

When the channel rate is set for 56xN, the LSB, Bit 8, is set to a logic 1. However, if FT1 ESFz and 56xN are configured, Bit 8 follows the value of Bit 7. Normally, only 64xN is applicable to the FT1 ESFz mode.

Consider the following functions when changing AUX FT1 SETUP:

- AUX FT1 CHAN function
- FT1 operating modes

AUX PRM — ESF Datalink Performance Report Message Control



The AUX PRM function determines how the PRM is transmitted and whether the PRM results are accumulated. The AUX function is only active when the ESF and ESFz operating modes are selected with the **MODE** switch.

PRM TRANSMIT — Press the **RESULTS I Results** switch to select one of the following as to how the PRM is transmitted from the T-BERD 209A.

EMUL CUSTOMER — Emulates the customer PRM. Selecting EMUL CUSTOMER sets the PRM C/R bit to 0.

EMUL CARRIER — Emulates the carrier PRM. Selecting EMUL CARRIER sets the PRM C/R bit to 1.

OFF — Disables the PRM transmitter.

When transmitting the PRM, the PRM SE bit is set to 1 when the T-BERD 209A detects and counts frame loss seconds in the received signal. The PRM SL bit is set to 1 when one or more timing slips occur. The PRM LB bit is set to 0.

PRM RCVR — Press the **RESULTS II Results** switch to turn the PRM receiver ON or OFF. When the PRM receiver is on, the T-BERD 209A reports on the PRM status in the BPV & FRAME category results.

Consider the following functions and results when changing AUX PRM:

- ESF and ESFz operating modes
- BPV & FRAME Category PRM results

5.3 DLC ANALYZER OPITON — AUXILIARY FUNCTIONS

Pressing the **AUX** switch illuminates the switch LED and displays the T-BERD DLC Analyzer Option auxiliary functions. Pressing the **AUX** switch a second time, causes the switch LED to go out and the display to return to the normal operating display.

Press the **FRAME** switch to scroll through the three auxiliary groups: CHANNEL, TRANSMIT, and TIME. The auxiliary group name appears in the FRAME window.

Press the **FORMAT** switch to scroll through the auxiliary functions within a selected auxiliary group. The auxiliary function name appears in the FORMAT window.

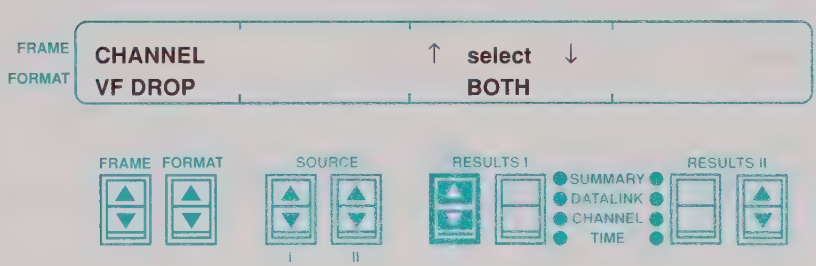
Press the **RESULTS I Results** or **RESULTS II Results** switch to select or modify the auxiliary function.

Table 5-3 lists the T-BERD DLC Analyzer Option auxiliary functions.

Table 5-3
T-BERD DLC Analyzer Option Auxiliary Functions

Auxiliary Function	Description
CHANNEL/VF DROP	T1 Source for Channel VF Drop
CHANNEL/CHANNEL SCROLL	Channel Scroll
CHANNEL/TRUNK TYPE	Channel Trunk Type
TRANSMIT/LBO	T1 Transmitter Line Build-Out
TIME/SET TIME	Set Time of Day
TIME/SET DATE	Set Date

CHANNEL/VF DROP — T1 Source for Channel VF Drop



The T1 Source for Channel VF Drop auxiliary function selects the T1 input source for the channel dropped to the speaker, VF OUT jack, and 2-WIRE VF interface. The auxiliary function also determines which input source(s) has active DTMF digit decoding and VF measurements.

Select — Press the **RESULTS I Results** switch to select one of the following:

PRIMARY — The DS0 channel is dropped from the PRIMARY RECEIVE input.

SECONDARY — The DS0 channel is dropped from the SECONDARY RECEIVE input.

BOTH — The DS0 channel is dropped from both the PRIMARY and SECONDARY RECEIVE inputs.

The CHANNEL category VF LEVEL, VF FREQ, and DTMF SEQ results measure the VF level and frequency and report the DTMF sequence for the selected line. When BOTH is selected, the VF FREQ result is not applicable.

CHANNEL/CHANNEL SCROLL — Channel Scroll

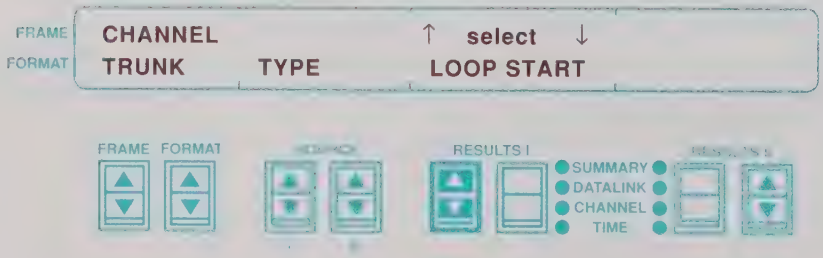
The Channel Scroll auxiliary function determines how the **PRIMARY CHANNEL** and **SECONDARY CHANNEL** switches scroll through the channel or timeslot numbers.

Select — Press the **RESULTS I Results** switch to select one of the following:

***BOTH* —** Pressing either switch changes both channel or timeslot numbers simultaneously.

***SEPARATE* —** The two switches operate independently of each other.

CHANNEL/TRUNK TYPE — Channel Trunk Type



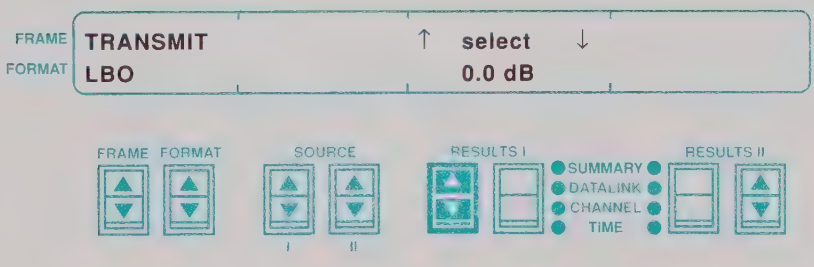
The Channel Trunk Type auxiliary function selects the trunk type signaling generated by the **ON HOOK, OFF HOOK,** and **RING** switches. The T-BERD DLC Analyzer is only configured to simulate the station end of a circuit and assumes the far end is sending office supervision signaling. The **RING** switch transmits office signaling. This auxiliary function is active in all framing modes except SLC-M2.

Select — Press the **RESULTS I Results** switch to select one of the following:

LOOP START — Enables the T-BERD DLC Analyzer to emulate or monitor standard signaling between a telephone and switch.

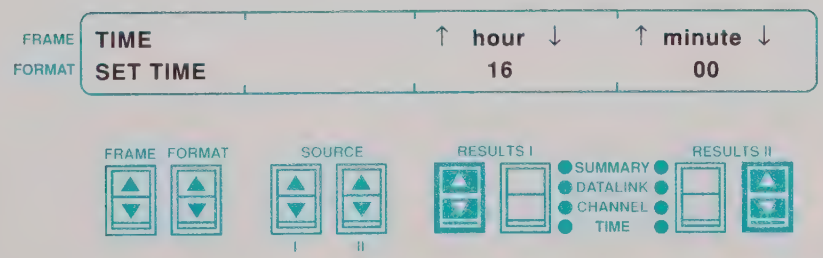
GND START — Enables the T-BERD DLC Analyzer to emulate or monitor a ground start foreign exchange or a SLC circuit.

TRANSMIT/LBO — T1 Transmitter Line Build-Out



The T1 Transmitter Line Build-Out (LBO) auxiliary function sets the transmitter LBO. Press the **RESULTS I Results** switch to select 0 dB, -7.5 dB, or -15 dB.

TIME/SET TIME — Set Time of Day



The Set Time of Day auxiliary function sets the time (in 24-hour format) for the battery-backed clock. The current time appears in the TIME category, TIME result.

Hour — Press the **RESULTS I Results** switch to set the current hour from 0 to 23 hours.

Minute — Press the **RESULTS II Results** switch to set the current minutes from 0 to 59 minutes.

TIME/SET DATE — Set Date

The Set Date auxiliary function sets the month and day for the battery-backed clock. The current month and day appear in the TIME category, DATE result.

Month — Press the **RESULTS I Results** switch to set the current month from JAN to DEC.

Day — Press the **RESULTS II Results** switch to set the current day of the month from 1 to 31.

SECTION 6
TEST RESULTS

TEST RESULTS

6.1 INTRODUCTION

This section describes the test results for the T-BERD 209A mainframe and the T-BERD DLC Analyzer Option.

6.2 MAINFRAME — TEST RESULTS

The T-BERD 209A performs a variety of measurements and provides a number of performance results. The measurements and test results are displayed in the RESULTS windows. This allows two different results to be displayed at the same time.

The categories are selected with the **RESULTS I** and **II Category** switches. Pressing the switch illuminates the category LED and displays the previously displayed category result. The category results are displayed by pressing the **RESULTS I** and **II Results** switches.

The six categories and the available results are listed as follows.

SUMMARY Category

Mainframe	Enhanced ESF Option
00-BIT ERRORS	17-FAR FRM ES
09-SLIPS	18-FAR FRM SES
25-VIOLATIONS	19-FAR BPV SEC
30-FRM ERRORS	20-FAR SLP SEC
32-CRC ERRORS	22-FAR CRC ERR
34-FRM LOS CNT	
40-RX FREQ Hz	
44-PULSE SHAPE	
51-TIMING SLIP	

LOGIC Category

Mainframe
00-BIT ERRORS
01-ASYN ER SEC
04-BIT ERR RT
05-ER FREE SEC
06-%EFS
07-SYN ERR SEC
08-OUT SYN SEC
09-SLIPS

G.821 Performance Analysis Option
10-SEV ERR SEC
11-%SEV ER SEC
12-DEGR MIN
13-%DEGR MIN
14-UNAVL SEC
15-%AVLBILITY
16-CSES

BPV & FRAME Category

Enhanced ESF Option
17-FAR FRM ES
18-FAR FRM SES
19-FAR BPV SEC
20-FAR SLP SEC
21-FAR PRM SEC
22-FAR CRC ERR
22-FCRC 1
22-FCRC 2-5
22-FCRC 6-10
22-FCRC11-100
22-FCRC101-319
22-FCRC>319
23-PAY SRC

Mainframe
25-VIOLATIONS
26-BPV SECONDS
27-BPV RATE
28-FRM ERR SEC
29-FRM SES
30-FRM ERRORS
31-FRM ER RATE
32-CRC ERRORS
33-CRC ERR SEC
34-FRM LOS CNT
35-FRM LOS SEC
36-CRC SES
37-CRC ERR RT

SIGNAL Category

Mainframe
40-RX FREQ, Hz
41-RX LEVEL (dBdsx)
42-RX LEVEL (dBm)
43-RX LEVEL (Vp-p)
44-PULSE SHAPE
45-PULSE WIDTH
46-RISE TIME
47-FALL TIME
48-UNDERSHOOT
49-OVERSHOOT
50-SPX CURRENT
51-TIMING SLIP
53-SLP ANA SEC

TIME Category

Mainframe

60-SIG LOS SEC
61-ALARMED SEC
62-TEST LENGTH
63-ELAPSE TIME
64-TEST END IN
65-CLOCK TIME
66-DATE

WANDER Category

Mainframe

70-WANDER +PK
71-WANDER -PK
72-P-P WANDER
73-15m WANDER
74-24h WANDER
75-TIE WANDER

6.3 MAINFRAME — SUMMARY CATEGORY

The following SUMMARY category displays key non-zero, out-of-specification, or PRM test results without having to scroll through all of the categories to find them.

00-BIT ERRORS

Bit Errors — A count of received bits which have a value opposite that of the corresponding transmitted bits (Mark or Space) after pattern synchronization is achieved.

09-SLIPS

Pattern Slips — A count of the total number of pattern slips since the beginning of the test.

17-FAR FRM ES

Far-End Frame Error Seconds — A count of the seconds in which one or more frame errors occurred in the received signal at the far end. This result reports on the PRM Frame-Synchronization-Bit Error Event Bit (FE = 1) status.

18-FAR FRM SES

Far-End Severely Errored Framing Seconds — A count of the seconds in which two or more frame errors occurred in less than 3 ms in the received signal at the far end. This result reports on the PRM Severely-Errored Framing Event Bit (SE = 1) status.

19-FAR BPV SEC

Far-End BPV Seconds — A count of the seconds in which one or more BPVs occurred in the received signal at the far end. This result reports on the PRM Line-Code Violation Event Bit (LV = 1) status.

20-FAR SLP SEC

Far-End Controlled Slip Seconds — A count of the seconds in which controlled slips occurred in the received signal at the far end. This result reports on the PRM Controlled-Slip Event Bit (SL = 1) status.

22-FAR CRC ERR

Far-End CRC Error Events — A count of the minimum number of CRC errors reported in the following 22-FCRC results. A ">" (greater than) preceding the count indicates that the Bins 2 through 6 are non-zero. This result reports on the PRM CRC Error Event Bits (G1 to G6) status.

25-VIOLATIONS

Bipolar Violation Count — A count of BPVs detected since the start of the test (excluding intentional violations found within B8ZS codes).

30-FRM ERRORS

Frame Errors — A count of the frame errors detected since the start of the test. For D4-compatible framing, frame errors are counted if either an Ft or an Fs frame bit is in error. For ESF framing, frame errors are counted on FPS bits. In T1 SLC mode, frame errors are counted only if an error is found on an Ft bit.

32-CRC ERRORS

CRC Errors — A count of CRC errors detected. CRC errors are counted only when ESF framing is present in the received T1 data.

34-FRM LOS CNT

Frame Loss Count — A count of discrete losses of frame synchronization that occurred during the test.

40-RX FREQ, Hz

Receive Frequency in Hz — The frequency of the clock recovered from the received data.

44-PULSE SHAPE

Pulse Shape — A PASS/FAIL result which shows whether the T1 pulse shape is within the boundary of the specified pulse mask.

51-TIMING SLIP

Controlled Timing Slips — Timing slips are counted when the RECEIVER input has slipped ±193 bit time periods from the T1 REF input. Single bit slips are displayed graphically next to timing slips.

In addition to the test results, the following status messages appear in the SUMMARY category as required.

ALL RESULTS OK — When all summary results are error-free or meet specification boundaries (e.g., RX FREQ Hz and PULSE SHAPE), this message appears in the display.

ALL RESULTS UNAVAILABLE — Displayed at test restart when the instrument has not synchronized with the received signal.

SIGNAL LOSS — The received signal has been lost. The receiver status LEDs are not illuminated, and the Alarm status LEDs are illuminated.

FAILED PATTERN — Indicates the failed test patterns when performing a BRIDGTAP or MULTIPAT test. The failed pattern is also indicated.

B8ZS DETECTED — Indicates the presence of B8ZS coding in the received signal when the **CODE** switch is set to the AMI position.

NOT B8ZS COMPATIBLE — Indicates the received signal is not B8ZS compatible when transmitting B8ZS encoded ALL ZEROS.

6.4 MAINFRAME — LOGIC CATEGORY

The following LOGIC category results are based on a bit error count. The results are updated each time a bit error is detected in the currently selected data pattern. When pattern synchronization is lost, the bit error count continues or halts based on the AUX HALT/CONT function setting.

00-BIT ERRORS

Bit Errors — A count of received bits which have a value opposite that of the corresponding transmitted bits (Mark or Space) after pattern synchronization is achieved.

01-ASYNC ERR SEC

Asynchronous Error Seconds — A count of test seconds where one or more bit errors occurred.

04-BIT ERR RT

Bit Error Rate — The ratio of bit errors to received pattern data bits.

05-ER FREE SEC

Error-Free Seconds — A count of the seconds during which pattern synchronization is maintained through the entire second and no bit error occurred.

06-% EFS

% Error-Free Seconds — The ratio, expressed as a percentage, of error-free seconds to the total number of seconds during which pattern synchronization is present.

07-SYN ERR SEC

Synchronized Error Seconds — A count of errored seconds synchronized to the occurrence of an error (the count and time interval begin with the occurrence of an error).

08-OUT SYN SEC

Out-of-Synchronization Seconds — A count of the total number of seconds, since the beginning of the test, during which pattern synchronization was not maintained for the entire second.

09-SLIPS

Pattern Slips — A count of the total number of pattern slips since the beginning of the test.

10-SEV ERR SEC

Severely Errored Seconds — A count of seconds during which the bit error ratio was worse than 10^{-3} within the available time.

11-%SEV ER SEC

% Severely Errored Seconds — The ratio, expressed as a percentage, of severely errored seconds to the number of available seconds.

12-DEGR MIN

Degraded Minutes — A count of minutes during which the bit error ratio was worse than 10^{-6}.

13-%DEGR MIN

% Degraded Minutes — The ratio, expressed as a percentage, of degraded minutes to the number of available minutes.

14-UNAVL SEC

Unavailable Seconds — A count of unavailable time.

15-%AVLBILITY

% Availability — The ratio, expressed as a percentage, of available seconds to the number of test seconds.

16-CSES

Consecutive Severely Errored Seconds — A count of the number of groups of three or more contiguous severely errored seconds in which an error rate worse than 10^{-3} was found in each second.

6.5 MAINFRAME — BPV & FRAME CATEGORY

The following BPV & FRAME category results monitor the T1 signal for BPVs, frame errors, ESF CRC errors, and the ESF datalink PRM. In this category, all test results are derived from bipolar violation (BPV) counts and frame error counts.

NOTE: When a far-end PRM result count is an approximation because of a lost PRM, a "~" (tilde) precedes the result. The results are halted when the frame synchronization or the signal is lost during testing. The message *UNAVAILABLE* appears in the far-end PRM results until either the ESF or ESFz mode is selected and the first PRM is received.

17-FAR FRM ES

Far-End Frame Error Seconds — A count of the seconds in which one or more frame errors occurred in the received signal at the far end. This result reports on the PRM Frame-Synchronization-Bit Error Event Bit (FE = 1) status.

18-FAR FRM SES

Far-End Severely Errored Framing Seconds — A count of the seconds in which two or more frame errors occurred in less than 3 ms in the received signal at the far end. This result reports on the PRM Severely-Errored Framing Event Bit (SE = 1) status.

19-FAR BPV SEC

Far-End BPV Seconds — A count of the seconds in which one or more BPVs occurred in the received signal at the far end. This result reports on the PRM Line-Code Violation Event Bit (LV = 1) status.

20-FAR SLP SEC

Far-End Controlled Slip Seconds — A count of the seconds in which controlled slips occurred in the received signal at the far end. This result reports on the PRM Controlled-Slip Event Bit (SL = 1) status.

21-FAR PRM SEC

Far-End Performance Report Seconds — A count of the total number of seconds, since test restart, in which a valid PRM was received.

22-FAR CRC ERR

Far-End CRC Error Events — A count of the minimum number of CRC errors reported in the following 22-FCRC results. A ">" (greater than) preceding the count indicates that the Bins 2 through 6 are non-zero. This result reports on the PRM CRC Error Event Bits (G1 to G6) status. When the result is displayed and the indicated count is an approximation of the actual CRC error count, a ">" (greater than) sign precedes the result count.

22-FCRC 1

Far-End CRC 1 Bin — A count of the seconds with only one CRC error reported in the received signal at the far end. This result reports on the first PRM CRC Error Event Bit (G1 = 1).

22-FCRC 2-5

Far-End CRC 2 to 5 Bin — A count of the seconds with 2 to 5 CRC errors reported in the received signal at the far end. This result reports on the second PRM CRC Error Event Bit (G2 = 1).

22-FCRC 6-10

Far-End CRC 6 to 10 Bin — A count of the seconds with 6 to 10 CRC errors reported in the received signal at the far end. This result reports on the third PRM CRC Error Event Bit (G3 = 1).

22-FCRC11-100

Far-End CRC 11 to 100 Bin — A count of the seconds with 10 to 100 CRC errors reported in the received signal at the far end. This result reports on the fourth PRM CRC Error Event Bit (G4 = 1).

22-FCRC101-319

Far-End CRC 101 to 319 Bin — A count of the seconds with 101 to 319 CRC errors reported in the received signal at the far end. This result reports on the fifth PRM CRC Error Event Bit (G5 = 1).

22-FCRC>319

Far-End CRC 320 to 333 Bin — A count of the seconds with 320 to 333 CRC errors reported in the received signal at the far end. This result reports on the sixth PRM CRC Error Event Bit (G6 = 1).

23-PAY SRC

Far-End Payload Source/Loopback — Identifies the direction of the PRM according to the PRM Command/Response Bit (C/R) and the Payload Loopback Activated Bit (LB). In end-to-end applications, a customer generated PRM is indicated as CUST (C/R = 0 and LB = 0) and a carrier generated PRM is indicated as CARR (C/R = 1 and LB = 0) in the display. In payload loopback applications, the customer generated PRM is indicated as CUST LOOP (C/R = 0 and LB = 1) when the customer is looped back and the carrier generated PRM is indicated as CARR LOOP (C/R = 1 and LB = 1) when the carrier is looped back.

25-VIOLATIONS

Bipolar Violation Count — A count of BPVs detected since the start of the test (excluding intentional violations found within B8ZS codes).

26-BPV SECONDS

BPV Seconds — A count of the seconds within which one or more BPVs occurred.

27-BPV RATE

BPV Rate — The ratio of BPVs to the number of data bits received.

28-FRM ERR SEC

Frame Errored Seconds — A count of the seconds during which one or more frame errors occurred.

29-FRAME SES

Severely Errored Frame Seconds — A count of the seconds during which the total number of frame errors equalled 12 or more (D4 framing only).

30-FRM ERRORS

Frame Errors — A count of the frame errors detected since the start of the test. For D4-compatible framing, frame errors are counted if either an Ft or an Fs frame bit is in error. For ESF framing, frame errors are counted on FPS bits. In T1 SLC mode, frame errors are counted only if an error is found on an Ft bit.

31-FRM ER RATE

Frame Error Rate — The ratio of frame errors to the number of analyzed framing bits.

32-CRC ERRORS

CRC Errors — A count of CRC errors detected. CRC errors are counted only when ESF framing is present in the received T1 data.

33-CRC ERRSEC

CRC Errored Seconds — A count of seconds within which one or more CRC errors are detected.

34-FRM LOS CNT

Frame Loss Count — A count of discrete losses of frame synchronization that occurred during the test.

35-FRM LOS SEC

Frame Loss Seconds — A count of seconds since initial frame synchronization during which one or more frame synchronization losses occurred or during which frame synchronization could not be achieved.

36-CRC SES

Severely Errored CRC Seconds — A count of seconds during which the total number of CRC errors and frame synchronization losses equalled 320 or more.

37-CRC ERR RT

CRC Error Rate — A count of CRC errors divided by the total number of ESF superframes analyzed.

6.6 MAINFRAME — SIGNAL CATEGORY

The following SIGNAL category test results analyze the input signal characteristics. The test results include received frequency, receive level, pulse shape, timing slip, and simplex current measurements.

40-RX FREQ, Hz

Receive Frequency in Hz — The frequency of the clock recovered from the received data.

41-RX LEVEL dBdsx

Receive Level in dBdsx — The level of the received signal in dB relative to a standard 3-volt base-to-peak signal (DSX level).

42-RX LEVEL dBm

Receive Level in dBm — The power level of an all-ones signal (applicable only when all ones is detected).

43-RX LEVEL V p-p

Receive Level in Volts — The level of the received signal in peak-to-peak volts. The signal level is displayed as V or mV when it is higher or lower than 1 volt, respectively.

44-PULSE SHAPE

Pulse Shape — A PASS/FAIL result which shows whether the T1 pulse shape is within the boundary of the specified pulse mask.

45-PULSE WIDTH

Pulse Width — The pulse width of a T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.

46-RISE TIME

Pulse Rise Time — The time interval between the 10% and 90% points of the rising edge of the T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.

47-FALL TIME

Pulse Fall Time — The time interval between the 10% and 90% points of the falling edge of the T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.

48-UNDERSHOOT

Undershoot — The level difference from the minimum point to the 0% point of the T1 pulse. UNDERSHOOT is displayed as a percent of the normalized pulse where the normalized pulse height equals 100%.

49-OVERSHOOT

Overshoot — The level difference from the maximum point to the 100% point of the T1 pulse. OVERSHOOT is displayed as a percent of the normalized pulse where the normalized pulse height equals 100%

50-SPX CURRENT

Simplex Current — The magnitude of the simplex current flowing between the transmit output tip and ring and the receive input tip and ring.

51-TIMING SLIP

Controlled Timing Slips — Timing slips are counted when the RECEIVER input has slipped ±193 bit time periods from the T1 REF input. Single bit slips are displayed graphically next to timing slips (see functional description).

53-SLP ANA SEC

Timing Slip Analysis Seconds — A count of test seconds during which Timing Slip Analysis has been performed.

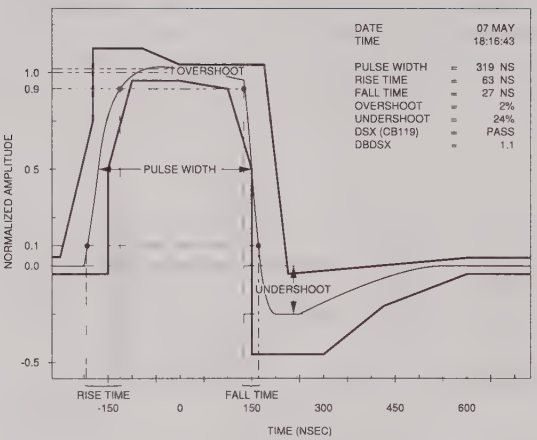
Measuring Pulse Shapes

The T-BERD 209A can measure the characteristics of a DS1 pulse waveform. In order to design equipment which can optimally receive a DS1 signal, constraints are placed on the shape of the signal that can be transmitted by DS1 equipment. This constraint is referred to as the pulse mask. A pulse mask is a graphical representation of the restrictions which are placed on the pulse shape. Figure 6-1 depicts a sample T-BERD 209A pulse mask and pulse waveform. The pulse shape results are also identified along with the pulse mask specifications.

The T-BERD 209A can be used to determine if a DS1 pulse is within specification by comparing the pulse shape to a pulse mask like the one shown in Figure 6-1. The T-BERD 209A is equipped with two such masks, which are selectable through the AUX PLS MASK function:

DSX (CB 119) — Selects the pulse mask conforming to AT&T Compatibility Bulletin 119 and ANSI T1.102 specifications. This mask is used to analyze the pulse shape at a DSX cross-connect.

NI (ANSI) — Selects the pulse mask conforming to the ANSI T1.403 Network Interface specification. This mask is used to analyze the pulse shape at the network interface.



EXPECTED PULSE SHAPE PARAMETERS

PARAMETER	MASK	
	DSX	NETWORK INTERFACE
Pulse Width	350 ± 56 ns	350 ± 56 ns
Rise Time	< 140 ns	< 152 ns
Fall Time	< 117 ns	< 125 ns
% Overshoot	< 15%	< 20%
%Undershoot	< 45%	< 45%

Figure 6-1
Pulse Shape and Pulse Mask Specifications

If desired, the DS1 pulse can be evaluated without comparing it to a mask by setting the AUX PLS MASK function to NONE. The T-BERD 209A is also equipped to output the pulse shape and mask to a graphics printer. The pulse shape printout is initiated by selecting the AUX GRAPH function and pressing the **RESULTS I Results** switch. Note that when NONE (no pulse mask) is specified, the pulse shape is printed without the pulse mask.

Measuring Timing Slips

The T-BERD 209A timing slip measurement (51-TIMING SLIP) identifies frequency deviations which cause uncontrolled and controlled clock slips. When measuring timing slips, a received T1 signal is compared with a reference T1 signal. The signal reference is taken from either the source attached to the side-panel EXT CLK IN connector or the front-panel T1 REF jacks. This comparison allows the T-BERD 209A to count the number of times that the edges of the received signal move past the edges of the reference signal (see Figure 6-2).

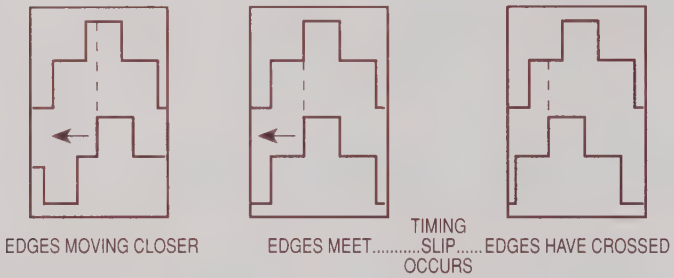


Figure 6-2
Timing Slips

The 51-TIMING SLIP result is displayed in three sections (see Figure 6-3): a numeric value, a bar graph, and a moving *wheel*.

Figure 6-3
Timing Slips Results Display

The numeric value (range 0 to 9999) represents the total number of frame slips (1 frame slip = 193-bit slips). The bar graph represents partial frame slips in increments of one bar per 16 bit slips (one wheel rotation); each time the bar moves to the end of the graph, it is reset to the middle position and the frame slip count is incremented. The wheel is used in conjunction with the bar graph to graphically display the direction, rate, and magnitude of timing slips. Figure 6-4 shows the values assigned to each position of the bar graph and the wheel.

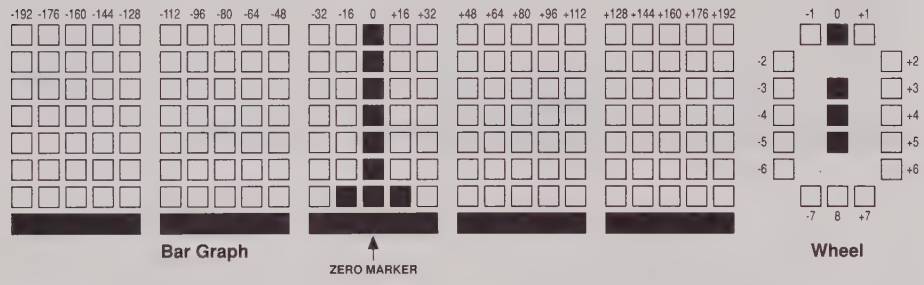
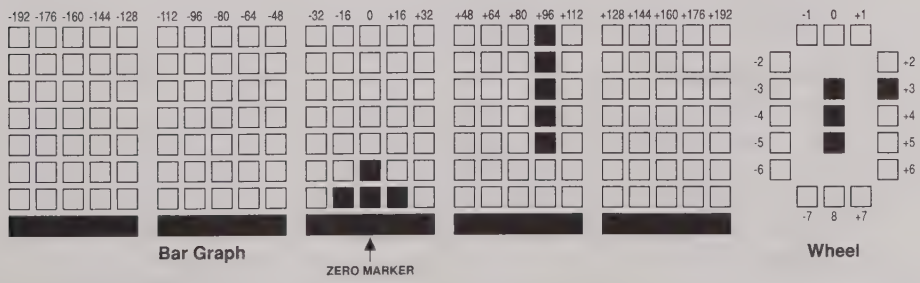
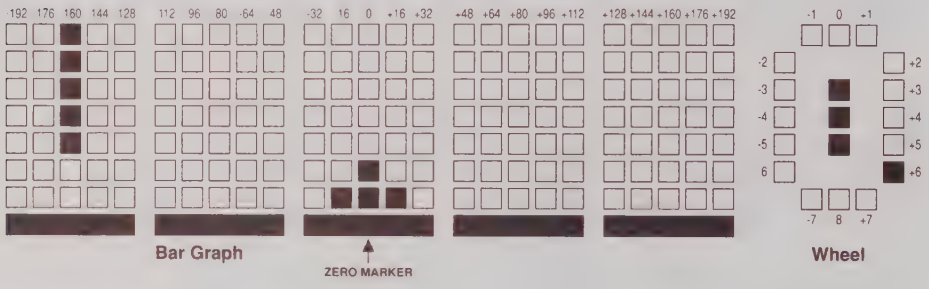


Figure 6-4
Bar Graph and Wheel Values

The magnitude of a timing slip is determined by adding the magnitude of the number indicated by the wheel position to the corresponding bar graph value. For example, if the display shows:



the bar graph value is +96 and the wheel value is +3; adding these two values results in a timing slip of +99 bits. That is, 99 more clock cycles have been received at the RECEIVE input than at the T1 REF input, or the RECEIVE input is receiving a higher frequency than the T1 REF input. If the display shows:



the bar graph value is -160 and the wheel value is +6, resulting in a timing slip of -154 bits.

6.7 MAINFRAME — TIME CATEGORY

The following TIME category offers time-related measurements such as signal loss seconds, test length, time remaining in a test, and current time and date.

60-SIG LOS SEC

Signal Loss Seconds — A count of test seconds during which the signal was not present or during which one or more signal losses occurred.

61-ALARMED SEC

Alarmed Second — A count of test seconds during which a Yellow, All Ones, Excess Zeros, or Ones Density alarm was detected.

62-TEST LENGTH

Length of a Timed Test — The currently set test length for a timed test, in HHH:MM format.

63-ELAPSED TIME

Elapsed Time — The number of hours, minutes, and seconds (1) since a proper frequency and level has been detected or (2) since the last major switch change.

64-TEST END IN

Time Remaining in Timed Test — Time remaining in a timed test, in HHH:MM:SS format.

65-CLOCK TIME

Clock Time of Day — The time of day in HH:MM:SS format.

66-DATE

Date — The date in DD MMM format.

6.8 MAINFRAME — WANDER CATEGORY

The following WANDER category results include peak-to-peak wander measurements.

70-WANDER +PK

Maximum Positive Peak Wander — The maximum positive peak wander deviation since the beginning of the test, defined in Unit Intervals (UIs).

71-WANDER -PK

Maximum Negative Peak Wander — The maximum negative peak wander deviation since the beginning of the test, defined in UIs.

72-P-P WANDER

Peak-to-Peak Wander — The total deviation of positive-to-negative peak wander since the beginning of the test, defined in UIs.

73-15m WANDER

Maximum Peak-to-Peak Wander Over 15 Minutes — The maximum peak-to-peak wander deviation over the last 15 minutes of the test. This result is unavailable for the first 15 minutes of the test and is updated once per minute thereafter.

74-24h WANDER

Maximum Peak-to-Peak Wander Over 24 Hours — The maximum peak-to-peak wander deviation over the last 24 hours of the test. This result is unavailable for the first 24 hours of the test and is updated once per hour thereafter.

75-TIE WANDER

Time Interval Error Wander — The variation in time delay of a given timing signal with respect to the T1 reference signal or external clock source over the test interval. Valid range is + 99999 UI.

Measuring Wander

The T-BERD 209A wander measurements identify the deviations in time between when pulse transitions ideally occur and when digital decoding gear expect them to occur. Wander is basically a slow form of jitter, occurring at frequencies less than 10 Hz; jitter time displacement occurs at rates greater than 10 Hz. If the received bit stream is impaired by wander, the receive frequency is different from that of the transmit frequency. As a result, the terminal clocks in more bits or fewer bits than it can clock out. Terminal devices typically compensate for the presence of wander with buffers that store additional bits. As long as wander does not occur in the same direction for an extended period of time, these buffers can compensate for wander's presence. But if wander exceeds the buffer length, the buffer overflows and data is lost or disrupted.

The wander test results are available only for T1 signals, and require the presence of a T1 reference signal taken from either the side-panel EXT CLK IN connector or from the front-panel T1 REF jack. Wander is measured in UIs; 1 UI is equivalent to a single T1 time slot or one bit space in a buffer. When measuring wander, the primary goal is to ensure that the amount of wander on the T1 signal is not exceeding an amplitude for which terminal buffers cannot compensate.

6.9 DLC ANALYZER OPTION — TEST RESULTS

The T-BERD DLC Analyzer Option performs a variety of measurements and provides a number of channel and datalink results. The measurements and test results are displayed in the RESULTS windows. This allows two different results to be displayed at the same time.

The categories are selected with the **RESULTS I** and **II Category** switches. Pressing the switch illuminates the category LED and displays the previously displayed category result. The category results are displayed by pressing the **RESULTS I** and **II Results** switches.

Most messages and results are preceded with either a "P" or "S" to indicate the input source, PRIMARY RECEIVE or SECONDARY RECEIVE.

The four categories and the available messages and results are listed as follows.

SUMMARY Category

Flashing Messages
P/S SIGNAL LOSS
P/S DATALINK SYNC LOSS
SW PROT FAILED
OPTION NOT INSTALLED

Current Alarm Messages
P/S MAJOR SHELF x
P/S MAJOR NO SHELF
P/S ALARM SHELF x
P/S SHELF x ON PROT
P/S FE LOOP PROTECT
P/S FE LOOP SHELF x
P/S MINOR
P/S PWR/MISC

Maintenance Messages
P/S MAINT PROCEED
P/S MAINT HOOK/SEIZE
P/S MAINT TEST ALARM

T1 Signal Errors
P/S VIOLATION
P/S FRM ERROR
P/S CRC ERROR

Results Messages
ALL RESULTS OK
ALL RESULTS UNAVAILABLE

DATALINK Category

Alarm Messages
P/S MAJOR SHELF x
P/S MAJOR NO SHELF
P/S ALARM SHELF x
P/S SHELF x ON PROT
P/S FE LOOP PROTECT
P/S FE LOOP SHELF x
P/S MINOR
P/S PWR/MISC

Maintenance Messages
P/S MAINT PROCEED
P/S MAINT HOOK/SEIZE
P/S MAINT TEST ALARM

Datalink Results
P/S SLC A SEC
P/S DL BITS
P/S ALM FIELD

CHANNEL Category

Channel Signaling
P/S TRAFFIC CHANNEL AB
P/S TRAFFIC CHANNEL ABCD
P/S TRAFFIC TIMESLOT AB

VF Results
P/S VF LEVEL
P/S VF FREQ
P/S DATA BITS
DTMF SEQ
P/S TS CH

TIME Category

TIME
DATE
P/S SIG L SEC

6.10 DLC ANALYZER OPTION — SUMMARY CATEGORY

The SUMMARY category displays flashing messages, current alarm messages, and key non-zero test results without having to scroll through all the categories to find them.

Flashing Messages

Flashing messages appear in the RESULTS I window indicating a signal loss, switching failure, or an option not installed. When a full-screen result appears, the flashing messages are not displayed. Depending on the message, some flash in the display once, while others flash until the condition is resolved.

P/S SIGNAL LOSS

Signal Loss — This message indicates the T1 signal has been lost after initial signal presence on the indicated receiver. The message flashes until the signal returns (T1 Pulses LED illuminated).

P/S DATALINK SYNC LOSS

Datalink Synchronization Loss — This message indicates that datalink synchronization has been lost after initial datalink synchronization. The message flashes until datalink synchronization is regained.

SW PROT FAILED

Switch to Protection Line Failed — This message indicates a switch to protect request cannot be completed. The message flashes once with each occurrence.

OPTION NOT INSTALLED

Option Not Installed — An option is not currently installed or available. The message flashes once with each attempt.

Alarm Messages

Alarm messages only appear in the SUMMARY category as they occur. The following alarm messages also appear in the DATALINK category as a current and historical record. The alarms are listed in a prioritized order. Higher priority messages supersede the lower priority messages.

P/S MAJOR SHELF x

Major Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by a shelf or shelf group (x = A, B, C, or D).

P/S MAJOR NO SHELF

Major Alarm, No Shelf — This message indicates a system state that is characterized by a loss of service to the subscribers with no associated shelf alarm.

P/S ALARM SHELF x

Shelf Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by the indicated shelf (x = A, B, C, or D).

P/S SHELF x ON PROT

Shelf x on Protection Line — This message indicates that one of the shelves has switched to the protection line (x = A, B, C, or D).

P/S FE LOOP SHELF x

Far-End Loop on Shelf x — This message indicates that a request is being sent to the far end to loop one of the four shelves (x = A, B, C, or D).

P/S FE LOOP PROTECT

Far-End Loop on Protection Line — This message indicates that a request is being sent to the far end to loop the protection line.

P/S MINOR

Minor Alarm — This message indicates a system state that is characterized by a non-service affecting fault.

P/S PWR/MISC

Power/Miscellaneous Alarm — This message indicates a power loss, high temperature, smoke, high water, open door, or other defined condition exists.

Maintenance Test Messages

These messages indicate a maintenance test is being performed. They appear in the DATALINK category as a historical record of the test.

P/S MAINT HOOK/SEIZE

On-Hook/Seize Maintenance Message — This message appears when either the on-hook or seize message is received.

P/S MAINT PROCEED

Proceed Maintenance Message — The maintenance bypass procedure continues or has succeeded.

P/S MAINT TEST ALARM

Test Alarm Maintenance Message — The maintenance bypass procedure has failed.

T1 Signal Errors

These signal errors only appear in the SUMMARY category when one or more errors are detected. These results remain in the SUMMARY category until a test restart occurs.

P/S VIOLATION

Bipolar Violation Count — A count of BPVs detected since the start of the test (excluding intentional violations found within B8ZS encoding).

P/S CRC ERROR

CRC Errors — A count of CRC errors detected. CRC errors are counted only when ESF framing is present in the received T1 data.

P/S FRM ERROR

Frame Errors — A count of the frame errors detected since the start of the test. For D4 or D1D framing, frame errors are counted if either an Ft or an Fs frame bit is in error. For ESF framing, frame errors are counted on FPS bits. For SLC-M1 or SLC-M2 framing, frame errors are counted only if an error is found on an Ft bit.

6.11 DLC ANALYZER OPTION — DATALINK CATEGORY

The following DATALINK category results act as a current and historical record of the alarm and maintenance messages that are received from the SLC datalink. The current and historical alarm and maintenance messages are cleared when the **HISTORY RESET** switch is pressed or a test restart occurs. This category is only available when the **FRAME** switch is set to SLC-M1 or SLC-M2, and initial frame and datalink synchronization have occurred.

Alarm Messages

The datalink alarm field identifies conditions that cause disruptions in customer service, changes in signal quality, changes in signal path, and mechanical integrity of the system. The alarms are generally classified as major and minor alarms. Major alarms indicate system failures that cause disruptions in customer service. These failures include excessive BPVs, frame loss, and continuous signal loss. Minor alarms indicate system conditions that occur to prevent a major alarm or identify a far-end loop. The following alarm messages also appear in the SUMMARY category.

P/S MAJOR SHELF x

Major Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by a shelf or shelf group (x = A, B, C, or D).

P/S MAJOR NO SHELF

Major Alarm, No Shelf — This message indicates a system state that is characterized by a loss of service to the subscribers with no associated shelf alarm.

P/S ALARM SHELF x

Shelf Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by the indicated shelf (x = A, B, C, or D).

P/S SHELF x ON PROT

Shelf x on Protection Line — This message indicates that one of the shelves has switched to the protection line (x = A, B, C, or D).

P/S FE LOOP SHELF x

Far-End Loop on Shelf x — This message indicates that a request is being sent to the far end to loop one of the four shelves (x = A, B, C, or D).

P/S FE LOOP PROTECT

Far-End Loop on Protection Line — This message indicates that a request is being sent to the far end to loop the protection line.

P/S MINOR

Minor Alarm — This message indicates a system state that is characterized by a non-service affecting fault.

P/S PWR/MISC

Power/Miscellaneous Alarm — This message indicates a power loss, high temperature, smoke, high water, open door, or other defined condition exists.

Maintenance Test Messages

The datalink maintenance field controls customer maintenance testing between the central office and remote terminal (RT). The maintenance test lasts approximately two seconds. The following messages only occur when the maintenance test is being performed.

P/S MAINT HOOK/SEIZE

On-Hook/Seize Maintenance Message — This message appears when either the on-hook or seize message is received.

P/S MAINT PROCEED

Proceed Maintenance Message — The maintenance bypass procedure continues or has succeeded.

P/S MAINT TEST ALARM

Test Alarm Maintenance Message — The maintenance bypass procedure has failed.

Datalink Status Results

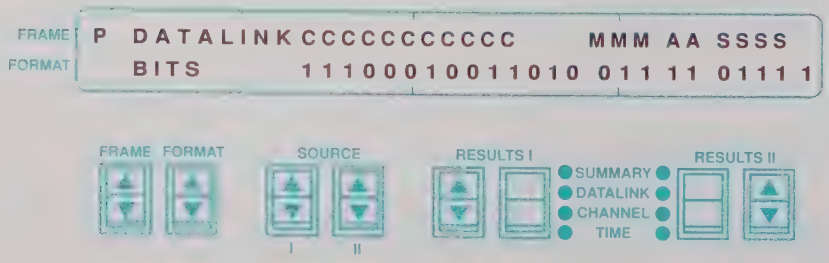
The following datalink status results indicate the number of seconds that alarms are detected, the datalink bit stream, and the alarm field format.

P/S SLC A SEC

SLC Alarmed Seconds — The number of test seconds during which datalink alarms, maintenance tests, or switch to protection line messages were detected.

P/S DL BITS

SLC Datalink Bits — This result displays the individual datalink bits. The display indicates the concentrator (CCCCCCCCCCC), maintenance (MMM), alarm (AA), and protection line switch (SSSS) fields. This result is only available when the T-BERD DLC Analyzer is frame synchronized in the SLC-M1 or SLC-M2 mode. The spoiler bits are shown without characters above them.



P/S ALM FIELD

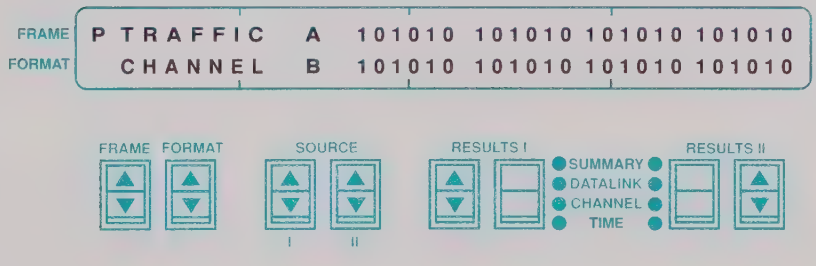
Alarm Field Format — Identifies the received datalink alarm field format as either 13 bit or 16 bit.

6.12 DLC ANALYZER OPTION — CHANNEL CATEGORY

The following CHANNEL category displays results for all 24 DS0 timeslot or channel signaling bits, data bits, and channel assignments for both primary and secondary receiver inputs. The results are only available after initial frame synchronization is achieved. The timeslot or channel signaling bit results require the entire display. The VF, data bit, and DTMF results are displayed in a single RESULTS window.

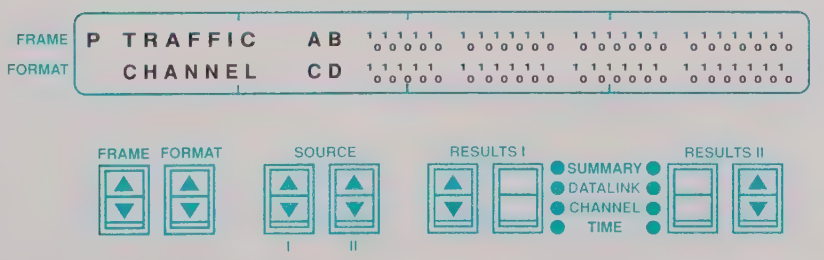
P/S TRAFFIC CHANNEL

AB Traffic Channel Signaling Bits — This result displays the A and B signaling bits in all 24 channels. This result is available in the SLC-M1, T1 D1D, T1 D4, and AUTO frame modes, but not SLC-M2 or T1 ESF.



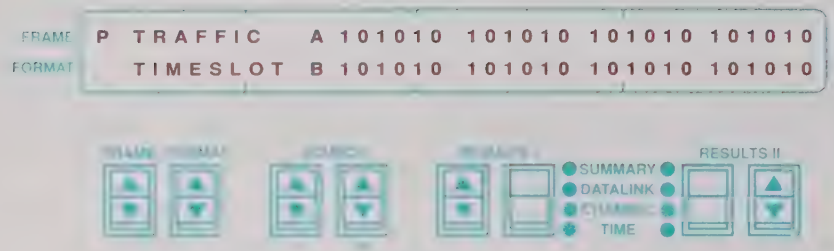
P/S TRAFFIC CHANNEL

ABCD Traffic Channel Signaling Bits — This result displays the A, B, C, and D signaling bits in all 24 channels. This result is only available in the T1 ESF frame mode.



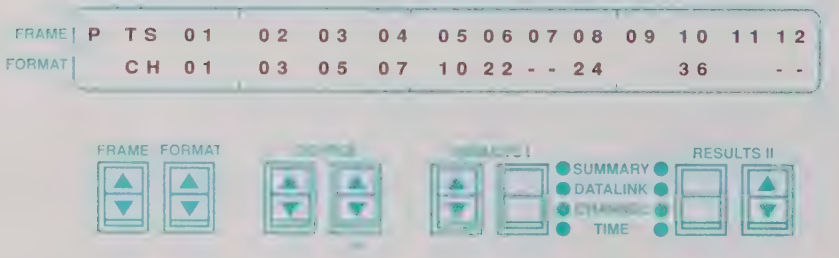
P/S TRAFFIC TIMESLOT

Traffic Signaling Bits for SLC-M2 Timeslots — This result displays the A and B signaling bits in all timeslots from a single receiver input. This is only available in the SLC-M2 frame mode.



P/S TS CH

SLC-M2 Timeslot Channel Assignments — This result displays the timeslot channel assignments of a Mode 2 SLC-96 circuit. An unassigned timeslot is indicated by two dashes (— —). An unknown timeslot assignment is left blank. This result is only available in the SLC-M2 frame mode and when the signal is received from the LDS. The result can be updated by sending the MAPPINGS command.



P/S VF LEVEL

Received VF Signal Level in dBm — A measurement of signal power in the currently selected DS0 channel.

P/S VF FREQ

Received VF Frequency — The VF frequency, measured in Hertz, of the received VF data in the currently selected DS0 channel.

P/S DATA BITS

DS0 Channel Data Bits — Displays the binary values of the selected DS0 channel.

DTMF SEQ

Dual-Tone Multi-Frequency Sequence — Displays 11 digits of the received telephone number in the currently selected DS0 channel.

6.13 DLC ANALYZER OPTION — TIME CATEGORY

The TIME category presents the current time, date, and the signal loss seconds results for the T-BERD DLC Analyzer.

TIME

Time of Day — The current time of day in HH:MM:SS format. This is set with the SET TIME auxiliary function.

DATE

Date — The current date in MMM DD format. This is set with the SET DATE auxiliary function.

P/S SIG L SEC

Signal Loss Seconds — A count of test seconds during which the signal was not present or during which one or more signal losses occurred after the initial signal detection.

SECTION 7
PRINTER OPERATION

PRINTER OPERATION

7.1 COMPATIBLE PRINTERS

The T-BERD 209A can generate printouts to an RS-232 serial printer such as the TTC PR-40A Thermal Printer. The T-BERD 209A RS-232 interface is configured to operate with the PR-40A without having to change any of the settings on either device.

7.2 RS-232 PRINTER OPERATION

The RS-232 Printer/Remote Control Interface enables you to obtain hard-copy printouts of pulse shape and TDR graphs, test results, alarm messages, and front-panel set-ups.

The RS-232 connector is configured to function as Data Communications Equipment (DCE); it may be directly connected to Data Terminal Equipment (DTE). Connection to other DCE is possible with the use of an adaptor cable. This RS-232 connector is a 25-pin female D connector located on the T-BERD 209A right side-panel. Auxiliary functions are used to select the baud rate, parity, and line terminator. Table 7-1 shows the selections available for configuring the RS-232 connector.

Table 7-1
RS-232 Printer/Controller Interface Configurations

Function	Selections
Baud rate	300, 1200, 2400, 4800
Word length*	7 bits (odd or even parity) 8 bits (no parity)
Line terminator	CR or CRLF
Column length	80 characters

* Word length is controlled by the parity selection, see AUX PARITY function.

The following Auxiliary functions are used to configure the RS-232-C interface (see Section 5):

AUX BAUD — Sets the RS-232 interface baud rate.

AUX PARITY — Sets the RS-232 interface parity.

AUX TERM — Sets the RS-232 interface line terminator.

To provide maximum operating flexibility, the use of the RS-232 signaling leads has been minimized. The interface monitors the Data Terminal Ready (DTR) line of the device to which it is connected. When this line is set true by the device, the T-BERD 209A assumes that the device is ready to accept a byte of data. The T-BERD 209A asserts Clear To Send (CTS) true whenever it is ready to accept a byte of data from an external controller.

Standard RS-232-C graphics compatible dot-matrix printers, like the TTC PR-40A Thermal Printer, can be connected to the T-BERD 209A to provide printouts of the test results, front panel set-up, and pulse shape tolerance and TDR (optional) graphs. The T-BERD 209A stores the printouts in nonvolatile memory which enables the printouts to be printed at any time during or after the test.

7.3 CONNECTING THE PRINTER

Perform the following procedure to connect the TTC PR-40A printer to the T-BERD 209A.

1. **AC power**
   Before connecting the printer to the T-BERD 209A, verify that the power is turned OFF.

2. **Connect the printer to the T-BERD 209A**
   Use a 25-position, D-type connector, cable with the pin assignments as described in Section 9.

3. **AC power**
   Turn the T-BERD 209A ON first, then the printer. If this step is reversed and the printer is ON LINE, the first printout can be garbled.

4. **Place the printer ON LINE**

The PR-40A must be placed ON LINE manually (see the *PR-40A Thermal Printer Operating Manual*). When the printer is placed ON LINE the T-BERD 209A immediately sends any printouts stored in memory.

NOTE: When connecting a compatible printer to the T-BERD 209A, connect the printer to the T-BERD 209A, turn the printer power ON first, and place the printer OFF LINE before turning the T-BERD 209A ON.

7.4 GENERATING A PRINTOUT

Printer operation is controlled through the front-panel **PRINT** and **PRINT EVENT** switches.

PRINT Switch — Press this switch to manually generate either a results or controls printout. The results printouts are hard-copy list of current test results. Controls printouts are hard-copy list of the T-BERD 209A current switch and auxiliary function settings.

PRINT EVENT Switch — This switch selects the event that automatically initiates a results printout. The labeled LEDs adjacent to the switch illuminate to reflect the current position of the switch. The switch positions and their functions are as follows:

OFF — No status or alarm messages are printed; all other positions enable the printing of status and alarm messages. Only manual prints can be initiated using the **PRINT** switch. When the **PRINT EVENT** switch is changed from one setting to OFF, all printer buffers are cleared; any previously stored test results or messages are not printed.

TEST END — If the T-BERD 209A is set for a timed test (selected by the **TEST** switch), the results are printed when the test interval has expired. The test interval is controlled through the AUX TEST LEN function.

ERROR — Results are printed when any of the following events occur: Logic errors, CRC errors, frame errors, BPVs, or changes in alarm conditions.

SEV ERR SEC — Results are printed when the bit error rate exceeds 10^{-3}. This selection is only available when the G.821 Performance Analysis Option is installed.

NOTE: A 6-hour backup printout is provided for both the ERROR and SEV ERR SEC positions. The printout is labeled BACKUP PRINT and occurs only if the print criterion has not been satisfied for 6 hours.

2 HR — Results are printed every 2 hours.

15 MIN — Results are printed every 15 minutes.

7.5 TYPES OF PRINTOUTS

The T-BERD 209A can generate four types of printouts: results, controls, messages, and graphic. Each printout is identified by a header and is time- and date-stamped.

7.5.1 Results Printouts

The T-BERD 209A generates three types of results printouts: standard, BRIDGTAP, and MULTIPAT results printouts. In addition, result overflow and the printer squelch function are also discussed.

Standard Results Printouts

The standard results printouts are hard-copy lists of current test results in various formats. Using the AUX PRNT FMT function, you can select one of the following results printout formats.

SHORT FORMAT — This results printout lists a standard set of results with additional results that are mode specific. The results that are printed in the short form for each mode are as follows:

All Modes	D4 and SLC Framing	ESF
TIME and DATE	FRM ERR	CRC ERR
BPV	FRM ER RT	CRC ERR SEC
BPV SEC	FRM L CNT	FRM L CNT
BPV RT	FRM L SEC	FRM L SEC
SIG L SEC	TEST LEN	
ALARMS	ELAP TIM	
BIT ERR		
ERR SEC		
BER		
OUT SYN SEC		
SLIPS		

SUMMARY PRINT — This results printout lists SUMMARY category results.

NORMAL FORMAT — This results printout lists all test results.

All three types of results printouts list any alarm LEDs that are illuminated at the time the printout is initiated. Figure 7-1 is an example of a normal results printout.

```
RESULTS PRINT                15:47:20          30 APR
BIT ERR                 0    ASYN E SEC             0
BER               0 E-07     EFS                   40
%EFS             100.00%     SY ERR SEC             0
OUT SY SEC              0    SLIPS                  0
SES                     0    %SES              00.00%
DEGR MIN                0    %DEGR MIN         00.00%
UNAVL SEC               0    %AVL             100.00%
CSES                    0    BPV ERR                0
BPV ER SEC              0    BPV RATE          0 E-07
FRA ER SEC              0    FRA ERR                0
F E RATE                0    E-06  CRC ERR         0
CRC ER SEC              0    FRA LOS                0
FRA LS SEC              0    CRC SES                0
CRC E RT          0 E-06     FREQ Hz          1544000
RX LVL       - 0.2dBdsx      RX VOLT     5.85 V p-p
SPX CUR     UNDER 10mA       TIMING SLIPS         *0
BIT SLIPS          +  0      SLP ANA SEC           40
SIG LS SC               0    ALARM SEC              0
TEST LEN      200:00:00      ELAP TIM      00:00:00
TEST END           ****      WANDER +PK         0 UI
WANDER -PK          0 UI     P-P WANDER         0 UI
TIE WANDER          0 UI

    ALARM/STATUS
T1                     ON    PATTERN SYNC         ON
FRAME SYNC             ON
```

Figure 7-1
Results Printout

BRIDGTAP Test Results Printouts

The BRIDGTAP results printout includes the bit errors (BIT ERR), errored seconds (ERR SEC), and pattern synchronization seconds (SYNC SEC) for each of the 21 patterns in the BRIDGTAP test pattern (see Figure 7-2).

When bit errors are not detected, BIT ERR and ERR SEC remain at zero and SYNC SEC indicates the number of seconds the synchronized pattern was received and monitored for errors. Each synchronized pattern is monitored for only 23 seconds during each cycle of the BRIDGTAP test.

In Figure 7-2, the 15-minute print event printout shows the ALL ONES to 2:10 patterns being monitored a second time (46 seconds), the 2:11 pattern is being repeated as the printout is generated (24 seconds), and the 2:12 to T1-QRSS patterns have been monitored once during the BRIDGTAP test. The 00-BIT ERRORS result equals the sum of the 21 BRIDGTAP test pattern bit errors. The 01-ASYN ER SEC result equals the sum of the 21 BRIDGTAP test pattern errored seconds. When pattern synchronization is lost, the SYNC SEC results are not counted.

```
    15MIN PRINT          18:04:50  12 MAR
BIT ERR          225423   ASYN E SEC       74
BER           2.13 E-0    OUT SY SEC        0
SLIPS                0   BPV ERR       32301
BPV ER SEC          10   BPV RATE 3.02 E-05
FRA ER SEC          97   FRA ERR        1525
F E RATE    2.12 E-04    FRA LOS           0
FRA LS SEC           0   SIG LS SC         0
ALARM SEC          164   ELAP TIM  00:15:00
BRIDGTAP RESULTS
PATTERN        BIT ERR   ERR SEC   SYNC SEC
ALL ONES             0         0         46
1:1                  0         0         46
1:3                  0         0         46
1:5                  0         0         46
1:6              16123         6         46
1:7              16124         5         46
2:8                  0         0         46
2:9                  0         0         46
2:10                 0         0         46
2:11                 0         0         24
2:12                 0         0         23
2:13                 0         0         23
2:14                 0         0         23
3 IN 18          54600        18         23
3 IN 19          27903        10         23
3 IN 20          44112        14         23
3 IN 21          49785        16         23
3 IN 22              0         0         23
3 IN 23          16776         5         23
3 IN 24              0         0         23
T1-QRSS              0         0         23
     ALARM/STATUS
ONE DEN HIST        ON   EX ZERO HIST    ON
ALL ONE HIST        ON   T1              ON
PATTERN SYNC        ON   FRAME SYNC      ON
```

Figure 7-2
Simulated Bridge Tap Results Printout

MULTIPAT Test Results Printouts

The MULTIPAT results printout includes the bit errors (BIT ERR), errored seconds (ERR SEC), and pattern synchronization seconds (SYNC SEC) for each of the five patterns in the MULTIPAT test pattern (see Figure 7-3).

When bit errors are not detected, BIT ERR and ERR SEC remain at zero and SYNC SEC indicates the number of seconds the synchronized pattern was received and monitored for errors. Each synchronized pattern is monitored for 175 seconds during each cycle of the MULTIPAT test.

```
   15MIN PRINT              18:04:50  12 MAR
BIT ERR          1340   ASYN E SEC      802
BER         9.96 E-07   OUT SY SEC        0
SLIPS               0   BPV ERR           0
BPV ER SEC          0   BPV RATE    0 E-09
FRA ER SEC          3   FRA ERR           3
F E RATE       4 E-07   FRA LOS           0
FRA LS SEC          0   SIG LS SC         0
ALARM SEC         372   ELAP TIM  00:15:00
  MULTIPAT RESULTS
PATTERN       BIT ERR   ERR SEC   SYNC SEC
ALL ONES          260   168            175
1:7               271   175            175
2 IN 8            270   167            175
3 IN 24           269   158            175
T1-QRSS           270   134            175
   ALARM/STATUS
ONE DEN HIST       ON   EX ZERO HIST    ON
ALL ONE HIST       ON   T1              ON
PATTERN SYNC       ON   FRAME SYNC      ON
```

Figure 7-3
Simulated Multipattern Results Printout

The 00-BIT ERRORS result equals the sum of the five MULTIPAT test pattern bit errors. The 01-ASYN ER SEC result equals the sum of the five MULTIPAT test pattern errored seconds. When pattern synchronization is lost, the SYNC SEC results are not counted.

Test Results Overflow

A results print is also automatically initiated when a result counter overflows. Labeled OVERFLOW PRINT, the printout also describes the reason for the overflow. Each time a result counter overflows, the test result is preceded by a double asterisk (**) on the printout, indicating an *immediate overflow* condition (i.e., the results counter overflowed during the last second). Subsequent printouts of the overflowed result are preceded by a single asterisk (*) to indicate a *previous overflow* condition. All asterisks are cleared at test restart.

Printer Squelch Control

When 20 or more printouts are generated in 60 seconds, the printer squelch is turned on temporarily halting the printouts. The squelched printouts include alarm, error, and severely errored second conditions that occur during a test. The twentieth printout indicates the squelch is turned on by printing the time-stamped message *SQUELCH ON*. When the printouts drop to five or less in 60 seconds, the time-stamped message *SQUELCH OFF* is printed and a squelch summary results printout is generated. The squelch summary printout provides the cumulative results when the squelch is turned off. The printer squelch does not affect messages indicating the squelch state, timed print requests (e.g., 6-hour backup print), manual print requests, and the *TEST COMPLETE* message. The printer squelch is reset when a test restart occurs.

7.5.2 Controls Printout

The controls printout lists the current setting of all front-panel switches and auxiliary functions. A controls printout is initiated by pressing the **PRINT** switch to the CONTROLS position. Figure 7-4 is an example of a controls printout.

```
   CONTROLS PRINT          16:13:03     27 OCT
MODE:          SELF TEST   PATTERN:       ALL ONES
TIMED/CONT:        TIMED   DIS HOLD:           OFF
TIMING:              INT   CODE:              AMI
ERR INS BPV:         OFF   ERR INS LOG:       OFF
ERR INS FRM:         OFF   RCV INPUT:        TERM
TX LBO:              0dB   PRI EVNT:          OFF
LP CD SELECT:CSU   LP UP   CD:              10000
LP DN CD:            100   RESPONSE:      NO AUTO
PARITY:             NONE   BAUD RATE:        2400
CR/CR-LF:             CR   FORMAT:          SHORT
INS RATE:1.0 E-6   BURST   LNGTH:             0mS
FRM ERR:          SINGLE   PULSE SEL:        NONE
HALT/CONT:          HALT
```

Figure 7-4
Controls Printout

7.5.3 Alarm Messages

Unless the **PRINT EVENT** switch is set to OFF, alarm messages are initiated automatically to inform you of any important developments related to your ongoing test. The alarm messages are are described in Appendix B. The alarm messages include the date, time, and alarm message in the following format:

```
HH:MM:SS DD:MM alarm message name
```

7.5.4 Graphic Printouts

When using a graphics compatible printer, it is possible to obtain a printout of the current pulse shape graph or optional TDR graph. Up to seven graphs can be stored in memory when a printer is not connected to the T-BERD 209A.

NOTE: To properly initiate a graphic printout, set the AUX PARITY function to NONE and the AUX TERM function to CR.

Pulse Shape Graph

The pulse shape graph printout is initiated using the AUX GRAPH function. Figure 7-5 shows a sample pulse shape printout. The pulse shape waveform can be compared to two different specifications, ANSI T1.403 Network Interface and ANSI T1.102. The pulse shape mask is selected through the AUX PLS MASK

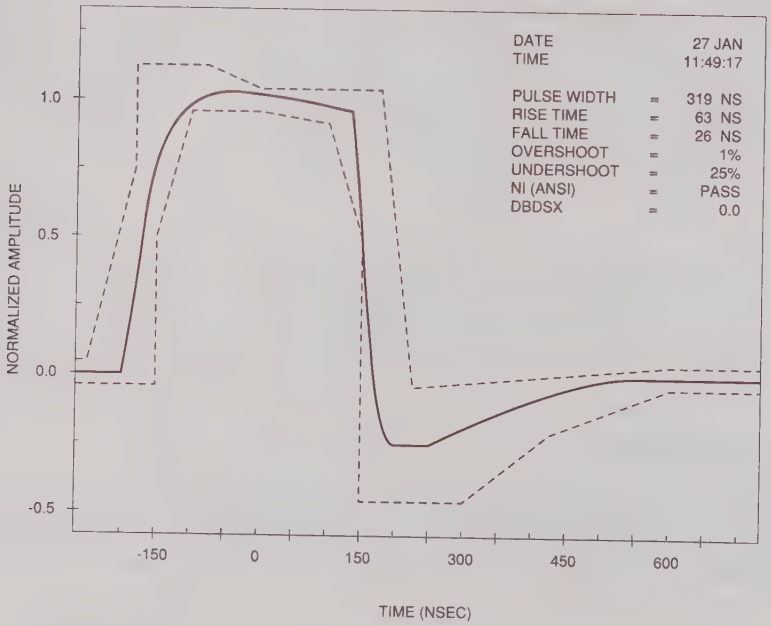


Figure 7-5
Sample Pulse Shape Printout

Printing TDR Graphs

Printing a TDR GRAPH is controlled through the **RESULTS II Category** switch. This switch performs two functions: setting up whether the graph printout generates one or two traces and initiating a TDR graph printout. The TDR graph printout can present the entire TDR trace with all the faults indicated or individual faults can be selected and printed. A graphics compatible printer, e.g., TTC PR-40A Thermal Printer, is required to print the TDR GRAPH.

Single and Dual Trace TDR Graphs

When the TDR RESULTS appear, the **RESULTS II Category** switch is labeled PRINT GRAPH which allows the TDR GRAPH to be printed. When NO REF appears in the TDR SETUP menu and the **RESULTS II Category** switch is pressed in the TDR RESULTS display, a single trace is printed from the current test results. When REF STORED appears in the TDR SETUP menu and the **RESULTS II Category** switch is pressed in the TDR RESULTS display, the current and reference trace are printed at the same time on the same graph.

Figures 7-6 and 7-7 illustrate the two types of graphs (single and dual trace) that are printed in the TDR mode. The single trace GRAPH in Figure 7-6 shows the reflection signature of a short charted against voltage and distance. The type of fault (if known), distance, and the TDR set-up parameters are also indicated on the printout. The numbered vertical bar in the graph indicates the position of the fault listed in the current TDR RESULTS. The two trace graph shown in Figure 7-7 identifies the reference trace as the dotted line (up turned trace is an open) and the current trace appears as the solid line. The vertical bar indicates the fault on the current trace (solid line).

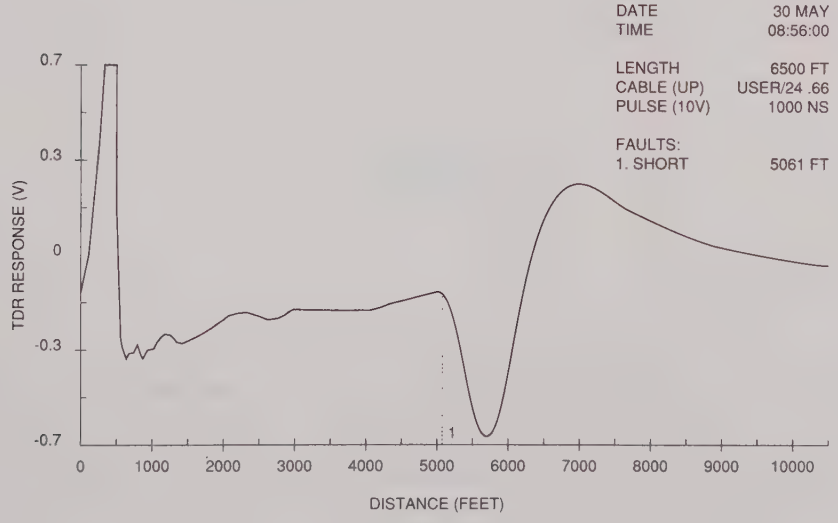


Figure 7-6
Single Trace TDR Graph

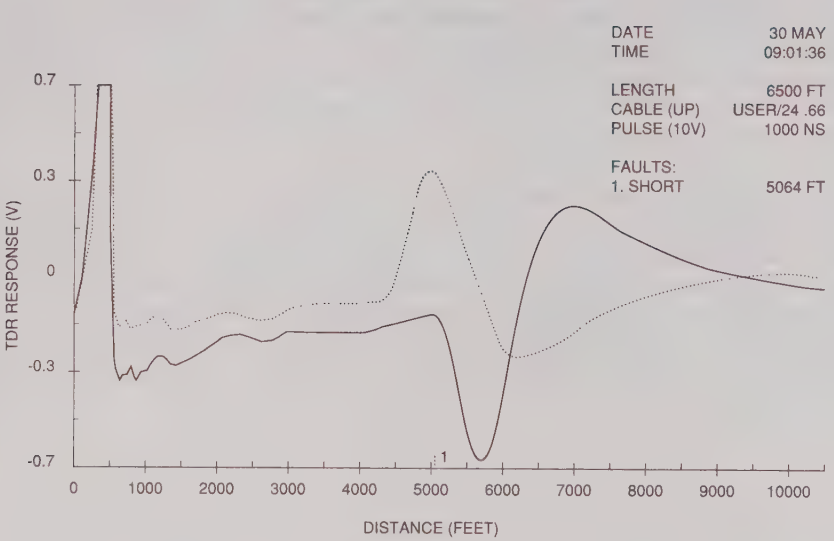


Figure 7-7
Dual Trace TDR Graph

Magnified TDR Graph

When more than one fault is detected and reported in the TDR RESULTS, each fault can be selected, magnified, and printed individually. This enables individual faults past the first fault to be better analyzed when the instrument detects the fault as UNRECognized in the initial printout. To print an individual fault, press the **RESULTS I Results** switch to select the desired fault in the TDR RESULTS display. After the fault is selected, press the **RESULTS II Category** switch to print the individual fault. The selected fault is enlarged and the distance scale adjusted in the printout as shown in Figure 7-8.

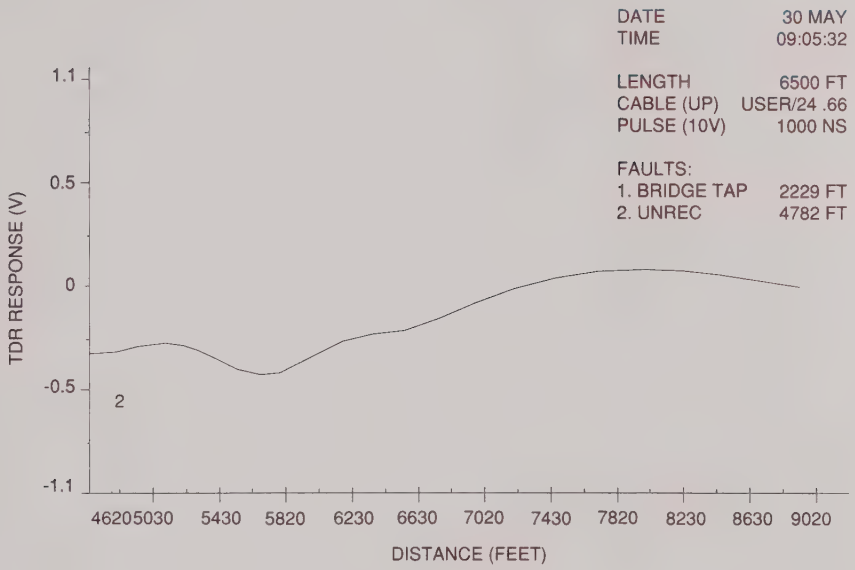


Figure 7-8
Magnified TDR Graph

SECTION 8
REMOTE CONTROL OPERATION

REMOTE CONTROL OPERATION

8.1 INTRODUCTION

This section describes the T-BERD 209A remote control capabilities when either a dumb terminal or computer is connected to the RS-232-C interface.

8.2 REMOTE CONTROL SETUP

During normal operation, the T-BERD 209A can be setup and controlled through an RS-232-compatible remote control device. This section describes the remote control capabilities, auxiliary functions, and setup procedure needed to configure the T-BERD 209A for remote control operation. Table 8-1 lists the interface capabilities available with the T-BERD 209A.

Table 8-1
T-BERD 209A Interface Capabilities

Function	Capabilities
Remote Interface	RS-232, female 25-pin D connector.
Data Rates	300, 1200, 2400, or 4800 bps.
Character Length	Seven bits with parity or eight bits without parity.
Line Terminator	CR or CRLF.
Flow Control	DTR/CTS or in-band XON/XOFF supported.
Parity	Odd, even, or none.
Interface Configuration	DCE.
Start Bits	One bit.
Stop Bits	Two bits on transmit, one or more on receive.
Column Width	40.
Timing	Asynchronous.
Character Format	ASCII.

8.2.1 Auxiliary Functions for Remote Control Setup

Table 8-2 lists the auxiliary functions used to configure the RS-232-C interface for remote control operation. The presentation of the T-BERD 209A test result, front-panel controls, and alarm and status message printouts sent to the remote control device are described in Appendix B.

Table 8-2
Auxiliary Function Parameters

Auxiliary Function	Definition	Selections
AUX BAUD	RS-232 Printer/Remote Control Baud Rate Select	300, 1200, 2400, or 4800
AUX PARITY	RS-232 Printer/Remote Control Parity Select	EVEN, ODD, or NONE
AUX TERM	RS-232 Printer/Remote Control Line Terminator	CR or CRLF

8.2.2 Remote Control Setup Procedure

Prior to entering remote control mode, you must first set baud and parity so that the T-BERD 209A is configured to communicate with the remote controller. Baud and parity can be configured in two ways:

- Manually using the AUX BAUD and AUX PARITY functions.
- Automatically using the Auto Baud function.

Manual Setup Procedure

The following setup procedure applies to configuring the RS-232 interface for remote control operation. The following settings should match the configuration of the remote control device.

1. **MODE switch**
   Select the AUX mode.

2. **Press the PATTERN switch to select the AUX BAUD function**
   Press the **RESULTS I Results** switch to select one of the following baud rates: 300, 1200, 2400, or 4800.

3. **Press the PATTERN switch to select the AUX TERM function**
   Press the **RESULTS I Results** switch to select one of the following line termination characters: CR or CRLF.

4. **Press the PATTERN switch to select the AUX PARITY function**
   Press the **RESULTS I Results** switch to select one of the following parity functions: ODD, EVEN, or NONE. When setting PARITY to ODD or EVEN, the number of data bits equals seven; when PARITY is set to NONE, the number of data bits equals eight.

Auto Baud Setup Procedure

The Auto Baud function allows baud, data bits, and parity values to be automatically configured. The Auto Baud function offers possible baud rate settings of 110, 300, 600, 1200, 2400, 4800, 9600, and 19200. Possible parity settings are even, odd, or none.

NOTE: Baud, parity, and data bit settings return to their original values when control of the T-BERD 209A is returned to the front panel.

To establish communication with the remote control unit through the Auto Baud function, perform the following steps at the remote control unit.

1. **BREAK key**
   Press the BREAK key three times slowly (once per second). On some terminals, the CTL key and the BREAK key must be pressed simultaneously.

2. **SPACEBAR**
   Press and hold the SPACEBAR until the message *Auto-baud achieved. Press ESCAPE to continue appears.* If the SPACEBAR does not have an auto-repeat function, press the SPACEBAR repeatedly until the message appears.

3. **ESCAPE key**
   Press the ESCAPE key and the message *Character format determined* appears.

NOTE: Between each of the above steps, the T-BERD 209A waits for 30 seconds. If no key is pressed within the 30-second period, the Auto Baud function is aborted.

Once the T-BERD 209A is configured to communicate with the controller, remote control mode may be entered by typing a valid remote control command or a period (.). The period sets the T-BERD 209A for terminal (CRT) control.

8.3 ERROR MESSAGES

Error messages are generated by improper command and parameter syntax, parameters out-of-range, or improper configurations. Error messages are formatted with the prefix **ERROR** or **WARNING**, and the message indicating the problem. The error and warning messages are described in Appendix B.

8.4 REMOTE CONTROL COMMAND FORMAT

This section describes the format, types of remote control commands, and the input and output sequence used to control the T-BERD 209A from a remote control device.

8.4.1 Command Formats and Entry Sequence

The general format for any remote control command is:

command name [parameter]

The **command name** entry specifies the name of the command to be executed. Where possible, commands which represent a front-panel switch or auxiliary function activity are abbreviated to reflect the first three characters of the switch or function. Control commands have no front-panel equivalent, and may either be abbreviated or spelled out.

The **[parameter]** entry specifies any optional parameter(s) associated with the command. If a parameter is entered, it should be separated from the command name by at least one space. The **command name [parameter]** string should always be followed by a carriage return or carriage return/line feed sequence.

Most remote control commands can be used to select a new command state or to display the current command state (without changing it). To select a new command state, enter both the command name and the desired parameter on the command line. To display the current state, enter the command name only. Note, however, that some commands (e.g., **CLS**) are *executable only* and have no current or changeable state.

8.4.2 Front-Panel Switch Commands

Switch commands control the functions normally associated with the T-BERD 209A front panel. Mnemonics represent the first three characters of the switch name or switch position as it appears on the T-BERD 209A front panel and in the display. Exponents are lowered to become the last digit of the number (e.g., 10^{-6} becomes 10-6).

Table 8-3 lists the switch commands along with their equivalent front-panel switch names. Brackets to the right of the switch name indicate the availability of associated parameters. The parameters associated with each command are described in Section 8.5.

Table 8-3
Front-Panel Switch Commands

Equivalent Front Command Name	Panel Switch
CODe [ ]	CODE
CONTROLS	CONTROLS PRINT
DISplay HOLd [ ]	DISPLAY HOLD
ERRor INSert BPV [ ]	BPV ERROR INSERT
ERRor INSert FRM [ ]	FRAME ERROR INSERT
ERRor INSert LOGic [ ]	LOGIC ERROR INSERT
HIStory RESet	HISTORY RESET
LOOp DOWn [ ]	LOOP DOWN
LOOp UP [ ]	LOOP UP
MODe [ ]	MODE
PATtern [ ]	PATTERN
PRInt [ ]	PRINT
PRInt EVEnt [ ]	PRINT EVENT
RECeive INPut [ ]	RECEIVE INPUT
RES 1 [ ]	RESULTS I Display
RES 2 [ ]	RESULTS II Display
RESTART	RESTART
RESULTS	RESULTS PRINT
TEST [ ]	TEST
TIMing [ ]	TIMING
TRAnsmit OUTput [ ]	TRANSMIT OUTPUT

8.4.3 Auxiliary Function Commands

Auxiliary commands control the functions normally associated with the T-BERD 209A AUX mode. Table 8-4 lists the auxiliary function commands along with their equivalent AUX mode names. Brackets following the command name indicate the command has associated parameters. The parameters associated with each command are fully described in Section 8.5.

Table 8-4
Auxiliary Function Commands

Equivalent Auxiliary Command Name	Function
Mainframe	
BAUd	AUX BAUD
BURst LENgth [ ]	AUX ERR SEL
CLOck [ ]	AUX CLOCK
DATa BITs	AUX PARITY
DATe [ ]	AUX DATE
ERRor RATe [ ]	AUX ER RATE
FRM ERRor LENgth [ ]	AUX FRM ERR, FRM ERR INS
FRM ERRor TYPe [ ]	AUX FRM ERR, T1 ESFz
GRAph [ ]	AUX GRAPH
HIStory CLR	AUX HIST CLR
LOOp	AUX ESF LOOP
LOOp CODe [ ]	AUX LP CODE
PARity	AUX PARITY
PGM LPDn [ ]	AUX PGM LPDN
PGM LPUp [ ]	AUX PGM LPUP
PGMPAT 1 [ ]	AUX USER1
PGMPAT 2 [ ]	AUX USER2
PRInt FMT [ ]	AUX PRNT FMT
PULse MASk [ ]	AUX PLS MASK
RESPONSE [ ]	AUX RESPONSE
SYNc LOSs ACTion [ ]	AUX HLT/CONT
TERM 232 [ ]	AUX TERM
TIMe SET [ ]	AUX TEST LEN

Table 8-4
Auxiliary Function Commands (Continued)

Fractional T1 Option	
FT1 CHAnnel [ ] FT1 IDLe [ ] FT1 RATe [ ]	AUX FT1 CHAN AUX FT1 SETUP, IDLE CODE AUX FT1 SETUP, DATA RATE
Battery Option	
PWR SAVe [ ]	AUX PWR SAVE
Advanced BERT Option	
LUP [ ]	AUX LUP
Enhanced ESF Option	
PRM EMUlate [ ] PRM RCV [ ]	AUX PRM, PRM TRANSMIT AUX PRM, PRM RCVR

8.4.4 Remote Control-Only Commands

The remote control-only commands have no front panel or auxiliary function equivalent. These commands are used to obtain information from the T-BERD 209A or to modify the remote control/printer protocol. Table 8-5 lists the remote control-only commands. Brackets following the command name indicate that the command has associated parameters. The parameters associated with each command are fully described in Section 8.5.

NOTE: With the exception of the **HELLO** and **LEDs** commands, all commands without brackets are *executable only* and have no status to return.

Table 8-5
Remote Control-Only Commands

Command	Description
ALArm [ ]	Alarm Message Prints
BEEp	Sound the Remote Control Unit's Beeper
CLEar FIFo	Clear the Print FIFO
CLS	Clear the Terminal Screen
DEVICE CLEAR	Clear Device
DISPLAY [ ]	Front-Panel Display Mode
ECHo [ ]	Echo Mode
FIRST P.U.	First Power-Up
FORMAT	Formatted Printouts
HELLO	Display T-BERD 209A Software Revision Level
HELP [ ]	On-Line Help Function
HOLD	Hold All Printer Outputs
LE	Display the State of Front-Panel LEDs
LOCal (/)	Return the T-BERD 209A to Local Mode
MESsages [ ]	Enable or Disable Error Message Printing
PRINT [ ]	Display a Single Result Value
PROmpt [ ]	Remote Control Command Prompt
RELease	Release All Printer Output
REMOTE	Remote Control Entry
SUMmary	Generate a Summary Printout
TERMINAL (.)	Configure the T-BERD 209A for Remote Control Operation
UNFORMAT	Unformatted Printouts

8.4.5 BERD-BASIC Commands

The T-BERD 209A remote control interface offers you the ability to create a BERD-BASIC program. A BERD-BASIC program is simply a sequence of commands that instruct the T-BERD 209A to perform desired functions. By taking control of the T-BERD 209A, a BERD-BASIC program can be executed (possibly many times) without the presence of a remote user.

A BERD-BASIC program line is composed of a remote control command and a line number. The command tells the T-BERD 209A what to do; the line number (any value between 0 and 29779) determines the order in which the commands are executed. Program lines may be entered in any sequence; the T-BERD 209A automatically sorts them in ascending order. A program is executed starting with the lowest numbered line and proceeding, in sequence, to the highest numbered line. Any line number that is not followed by a command is deleted.

Table 8-6 lists the BERD-BASIC commands. Each BERD-BASIC command is fully described in Section 8.5.

Table 8-6
BERD-BASIC Commands

Command	Description
CONT	Resume BERD-BASIC Program Execution
END	End a BERD-BASIC Program
GOTO	Transfer Program Execution to a Specified Line
INPUT	Enter User Input Into a Macro
LIST	List the Working BERD-BASIC Program
LPRINT	Print a Literal Text String
MACRO	Set or Display User Macros
NEW	Enter a New BERD-BASIC Program
REMark	Remark or Comment
RUN	Execute a BERD-BASIC Program
STOP	Suspend Execution of a BERD-BASIC Program

8.4.6 TDR Commands

TDR commands control the functions normally associated with the TDR Option. Table 8-7 lists the commands, their equivalent front-panel display names, and related switches. Brackets to the right of the switch name indicate the availability of associated parameters. The parameters associated with each command are described in Section 8.5.

Table 8-7
TDR Commands

Command Name	Related Switch or Function
CABle [ ]	CABLE
GRAph [ ]	PRINT GRAPH
LENgth [ ]	LENGTH
MODe [ ]	**MODE** Switch
PRInt [ ]	**PRINT** Switch
REFerence [ ]	**RESULTS II Category** Switch
RESTART	**RESTART** Switch
VELocity [ ]	USER PR. VEL

8.4.7 Input Sequence

A remote control command consists of an ASCII character string followed by either a carriage return (CR) or a carriage return/line feed (CR/LF) sequence. When specifying a remote control command, the following rules apply:

- Commands may be entered in lower or upper case.
- Spaces may be inserted before (or after) the command name. Spaces must be inserted between the command name and a parameter.
- Entering a CTL C (Control C) or a CTL X (Control X) prior to issuing a CR or LF cancels the input line.
- Entering a CTL H (Control H) or BACK SPACE erases the last character entered.
- Up to 20 previously entered commands can be recalled using the ESC key. When the number of previously entered commands exceeds 20, the earliest command entries are overwritten.

After receiving a carriage return or a carriage return/line feed sequence, the T-BERD 209A analyzes the data in its input buffer. If a parity error, overrun error, framing error, input buffer overflow, program memory overflow, or any syntax error is detected, the appropriate error message is returned to the controller. If no errors are detected, the command is decoded and the appropriate response is generated.

If the ECHo feature is enabled, the entered characters are echoed back to the controller. If the **PROmpt** command is enabled, the default prompt (>) or a user-defined prompt (a single character or a string) indicates that previous commands have been processed and that the T-BERD 209A is ready to receive additional commands. Note that the **TERMINAL** command automatically enables the **ECHo** and **PROmpt** commands when entering remote control mode. When either the **PROmpt** or **ECHo** command is enabled, any characters used to cancel a line (e.g., CTL C) are echoed to the remote control unit.

8.4.8 Output Sequence

The following rules apply for output sequence:

- If the **ECHo** command is enabled, echoed outputs have higher priority than the printer outputs. This means that printer output is suspended if there are any echoed outputs available (include user inputs or error messages) at the end of each line of printer output. Printer output resumes when the echo FIFO is empty.

- The **HOLD** command suspends printer output until the **RELease** command is specified. When the **HOLD** command is specified, the prompt character automatically changes to a plus (+) sign to remind you that data is waiting to be printed. After the **RELease** command is entered, the default prompt (>) or the user-defined prompt is returned.

- CTL S suspends printer output without changing the prompt character. Entering CTL Q (Control Q), a carriage return, or CTL S a second time releases printer output suspended by CTL S.

- Entering CTL C (Control C) clears the entire printer FIFO.

8.5 REMOTE CONTROL COMMANDS

This section describes all of the remote control commands in alphabetical order. The command, parameters, related commands, and examples are provided for each command.

ALArms **ALArms**

Alarm Message Prints

ALArms [ON | OFF]

This command sets or prints the alarm message printout function. The command controls whether alarm, status, and note messages are printed when a print event is selected with the **PRInt EVEnt** command.

ALArms :Print the alarm message printout status.

ALArms ON :Enable the alarm message printout control. Alarm, status, and note messages are printed when a print event is selected. When the **PRInt EVEnt** command is **OFF**, the **ALArms ON** command has no effect.

ALArms OFF :Disable the alarm message printout control. Alarm, status, and note messages are not printed when a print event is selected.

See also: **PRInt EVEnt**

EXAMPLE:

```
>ALA OFF          :Disable the alarm message printout control.
>ALA              :Print the current alarm message printout status.
OFF               :The alarm message printout control is disabled.
>
```

BAUd

BAUd

Display the Current Baud Rate Setting

BAUd :Prints the current RS-232 interface baud rate. The baud rate can only be changed from the front panel (AUX BAUD function). Note that **BAUd** is an inquire-only command; you cannot change the baud rate through the remote control device.

EXAMPLE:

```
>BAU                    :Display the current baud rate setting.
1200
>BAU 2400               :Try to set a new baud rate.
ERROR: Baud is not an executable command.
>
```

BEEp

BEEp

Sound the Remote Control Unit's Beeper

BEEp :Causes the remote control unit to sound a single short beep.

EXAMPLE:

```
>BEEp                   :Sound the terminal beeper once.
>BEEp                   :Sound the terminal beeper again.
>
```

BURst LENgth **BURst LENgth**

Burst Duration For BPV and Logic Errors

BURst LENgth [< 0.025 | 0.050 to 0.20 > | < 0.25 | 0.75 to 0.5 > | < 0.6 | 0.7 to 1.5 > | < 2.0 | 2.5 to 5.0 >]

This command sets or prints the logic error or BPV insertion burst duration from 25 ms to 5000 ms.

BURst LENgth	:Print the current burst duration.
BURst LENgth [0.025 | 0.050 to 0.20]	:Set the burst duration from 0.025 (25 ms) to 0.2 (200 ms) seconds in 0.025 (25 ms) second steps.
BURst LENgth [0.25 | 0.75 to 0.5]	:Set the burst duration from 0.25 (250 ms) to 0.5 (500 ms) seconds in 0.05 (50 ms) second steps.
BURst LENgth [0.6 | 0.7 to 1.5]	:Set the burst duration from 0.6 (600 ms) to 1.5 (1500 ms) seconds in 0.1 (100 ms) second steps.
BURst LENgth [2.0 | 2.5 to 5.0]	:Set the burst duration from 2.0 (2000 ms) to 5.0 (5000 ms) seconds in 0.5 (500 ms) second steps.

NOTE A value that is not one of the incremental values is always rounded to the nearest allowable lesser value. If a value has a decimal point, the digits after the third fractional position are ignored.

See also: **ERRor INSert BPV** and **ERRor INSert LOGic**

EXAMPLE:

>BUR LEN 0.024	:The smallest allowed decimal value is 0.025.
ERROR: PARAMETER IS OUT OF RANGE	
>BUR LEN 5.001	:The largest allowed decimal value is 5.000.
ERROR: PARAMETER IS OUT OF RANGE	
>BUR LEN 3.0	:A 3-second burst duration is specified.
>	

CABle **CABle**

Select TDR Cable Type and Wire Gauge

CABle [PIC/22 | PIC/24 | PIC/26 | JELL/22 | JELL/24 | JELL/26 | PULP/22 | PULP/24 | PULP/26 | USER/22 | USER/24 | USER/26]

This command sets or prints the TDR cable type and wire gauge to configure the TDR. Refer to Table 3-4 for PR. VEL.

CABle	:Print the current TDR cable type and wire gauge.
CABle PIC/22	:Select 22 gauge PIC (polyethylene insulated cable) wire.
CABle PIC/24	:Select 24 gauge PIC wire.
CABle PIC/26	:Select 26 gauge PIC wire.
CABle JELL/22	:Select 22 gauge jelly-filled insulated wire.
ABle JELL/24	:Select 24 gauge jelly-filled insulated wire.
CABle JELL/26	:Select 26 gauge jelly-filled insulated wire.
CABle PULP/22	:Select 22 gauge paper-pulp insulated wire.
CABle PULP/24	:Select 24 gauge paper-pulp insulated wire.
CABle PULP/26	:Select 26 gauge paper-pulp insulated wire.
CABle USER/22	:Select 22 gauge generic wire. Select PR. VEL with the **VELocity** command.
CABle USER/24	:Select 24 gauge generic wire. Select PR. VEL with the **VELocity** command.
CABle USER/26	:Select 26 gauge generic wire. Select PR. VEL with the **VELocity** command.

See also: **GRAph, LENgth, MODe, PRInt, REFerence, RESTART,** and **VELocity**

EXAMPLE:

>CAB	:Print current cable type and wire gauge.
PIC/22	:Current cable type is 22 AWG PIC.
>CAB JELL/24	:Change type to jelly-filled 24 gauge.
>	

CLEar FIFo

CLEar FIFo

Clear the Print FIFO

CLEar FIFo :Clears the print FIFO of all printouts that are awaiting printing.

EXAMPLE:

>CLEar FIFo :Clear the print FIFO.
>

CLOck

CLOck

Clock Time

CLOck [hh:mm]

This command sets or prints the clock time (time of day).

CLOck :Print the current clock time.

CLOck hh:mm :Set the clock time. The time is entered in 24-hour format; seconds are always set to zero when a new time is entered.

EXAMPLE:

> CLO :Print the current clock time.
15:30:24 :Time is displayed in hours, minutes, and seconds.
> CLO 6:28 :Set clock time to 6:28 a.m.
>

CLS

CLS

Clear the Terminal Screen

CLS :This command clears the terminal screen by sending 30 returns to the screen.

CODe

CODe

Select Code Type

CODe [AMI | B8Zs]

This command sets or prints the code type used by the T-BERD 209A transmitter.

CODe :Print the current code status.

CODe AMI :Set the coding for AMI.

CODe B8Zs :Set the coding for B8ZS encoding. Note that B8ZS decoding is always available on the receive side.

EXAMPLE:

>COD :Print the current code status.
AMI
>COD B8Z :Set B8ZS encoding.
>

CONT CONT

Resume BERD-BASIC Program Execution

CONT :This command resumes the running of any BERD-BASIC program which has been suspended due to the **STOP** command. Using the **STOP** and **CONT** commands, you can temporarily suspend program execution and resume it at a later time. Program execution cannot be continued if any existing line in a program has been changed, or if a program has reached its conclusion.

See also: **STOP**

EXAMPLE:

```
>10 LPRINT "FIRST HALF"        :This program runs in two halves ...
>20 STOP                       : ...with a STOP in the middle.
>30 LPRINT "SECOND HALF"
>40 END
>RUN                           :Run the program.
FIRST HALF                     :The program stops running ...

BREAK IN LINE 20               : ...due to the STOP command in line 20.

>CONT                          :Continue running the program.
SECOND HALF
*DONE*                         :The program is finished.
>
```

CONTROLS

CONTROLS

Generate a Controls Printout

CONTROLS :This command generates a controls printout of all current T-BERD 209A switch settings. This command performs the same function as the **PRInt CONtrol** command.

EXAMPLE:

>CONTROLS :Generate a controls printout.

```
  CONTROLS PRINT        16:13:03    27 OCT
MODE:       SELF TEST   PATTERN:  ALL ONES
TIMED/CONT:     TIMED   DIS HOLD:       OFF
TIMING:           INT   CODE:           AMI
ERR INS BPV:      OFF   ERR INS LOG:    OFF
ERR INS FRM:      OFF   RCV INPUT:     TERM
TX LBO:           0dB   PRI EVNT:       OFF
LP CD SELECT:     CSU   LP UP CD:     10000
LP DN CD:         100   RESPONSE:  NO AUTO
PARITY:          NONE   BAUD RATE:     2400
CR/CR-LF:          CR   FORMAT:       SHORT
INS RATE:     1.0 E-6   BURST LNGTH:    0mS
FRM ERR:       SINGLE   PULSE SEL:     NONE
HALT/CONT:       HALT

>
```

DATa BITs

DATa BITs

Display the Current RS-232 Data Bit Setting

DATa BITs :This command only prints the current data bit setting for the RS-232 interface on the T-BERD 209A. Note that this is an inquire-only command; you cannot change the setting via remote control.

EXAMPLE:

>DAT BIT :Print current data bits.
7
>

DATe

DATe

Calendar Date

DATe [dd/mm]

This command sets or prints the current date from the T-BERD 209A.

DATe :Print the current date.

DATe dd/mm :Set the date with the day and month of the year.

EXAMPLE:

>DAT :Print the current date.
4 SEP
>DAT 18/5 :Set date to May 18.
>

DEVICE CLEAR

DEVICE CLEAR

Clear Device

DEVICE CLEAR :This command clears the T-BERD 209A by executing the power-up procedure. The entire instrument is reinitialized — hardware and RAM.

NOTE: It also returns control of the T-BERD 209A to the front panel. Remote control mode must be reestablished.

DISplay HOLd

DISplay HOLd

Freeze the Results Displays

DISplay HOLd [ON | OFF]

This command sets or prints the display hold function.

DISplay HOLd :Print the current status of the display hold function.

DISplay HOLd ON :Enable the display hold function. The displayed test results are frozen, however, the the test results continue to accumulate.

DISplay HOLd OFF :Disable the display hold function. The displayed test results are unfrozen and updated.

EXAMPLE:

>DIS HOL :Print the current status of the display hold function.
OFF
>DIS HOL ON :Enable the display hold function.
>

DISPLAY

DISPLAY

Front-Panel Display Mode

DISPLAY [LOCal | REMote]

This command sets or prints the **RESULTS** switches display mode. These are the only switches that can be activated under remote control.

DISPLAY	:Print the **RESULTS** switches display mode status.
DISPLAY LOCal	:Enable the front-panel **RESULTS** switches. This command is the default for remote control mode.
DISPLAY REMote	:Disable the front-panel **RESULTS** switches.

EXAMPLE:

>DISPLAY	:Print the **RESULTS** switches display mode status.
LOCAL	
>DISPLAY REM	:Disable the front-panel **RESULTS** switches.
>	

ECHo ECHo

Echo Mode

ECHo [ON | OFF]

This command sets or prints the echo mode function.

ECHo	:Print the echo mode function status.
ECHo ON	:Enable the echo mode function. This allows the commands to be displayed on the remote control device.
ECHo OFF	:Disable the echo mode function. This prevents the commands from being displayed on the remote control device.

EXAMPLE:

>ECH	:Print the echo mode function status.
ON	
>ECH OFF	:Disable the echo mode function.
>	:Enter the **CLOck** command. **CLO** is not displayed.
12:03:32	:However, the time is displayed.
>	

END

END

End a BERD-BASIC Program

END :This command marks the end and terminates a BERD-BASIC program. The message **DONE** is sent to the remote control device when the program is terminated. Note that the message **DONE** is sent whenever the end of a program is reached successfully (even if the **END** command is not specified).

EXAMPLE 1:

```
>10 LPRINT "HI"
>RUN
HI
*DONE*
```

EXAMPLE 2:

```
>10 LPRINT "HELLO"
>20 LPRINT "HOW ARE YOU"
>30 END
>RUN
HELLO
HOW ARE YOU
*DONE*
>
```

ERRor INSert BPV

BPV Error Insertion

ERRor INSert BPV [RATe | BURst | SINgle | OFF]

This command sets or prints the BPV error insertion function.

ERRor INSert BPV	:Print the current BPV error insertion rate status.
ERRor INSert BPV RATe	:Continuously insert BPVs into the data stream. The **ERRor RATe** command determines the insertion rate. The **ERRor INSert BPV OFF** command disables the error insertion.
ERRor INSert BPV BURst	:Insert a single burst of BPVs. The **ERRor RATe** command determines the insertion rate of the burst. The **BURst LENgth** command determines the burst duration. Note that an error message is printed when the burst length is set to 0 ms.
ERRor INSert BPV SINgle	:Insert a single BPV. If continuous errors are being inserted, this command can also stop the error insertion.
ERRor INSert BPV OFF	:Stop the insertion of BPV errors.

See also: **ERRor RATe** and **BURst LENgth**

EXAMPLE:

>ERR INS BPV	:Print the current BPV error insertion rate status.
OFF	:BPV insertion rate is off.
>ERR INS BPV RAT	:Turn on the continuous BPV insertion rate.
>ERR INS BPV SIN	:Insert a single BPV and end rate insertion.
>ERR INS BPV	:Print the current BPV error insertion rate status.
OFF	
>	

ERRor INSert FRM

Frame Error Insertion

ERRor INSert FRM [CONT | MULTI | SIN | OFF]

This command sets or prints the frame error insertion function.

ERRor INSert FRM	:Print the current frame error insertion rate status.
ERRor INSert FRM CONTinuous	:Continuously insert single or multiple consecutive frame errors into the data stream. The **FRM ERRor LENgth** command determines the number of frame errors inserted into one frame. The **ERRor INSert FRM OFF** command stops the frame error insertion.
ERRor INSert FRM MULtiple	:Insert one round of single or multiple consecutive frame errors into the data stream. The **FRM ERRor LENgth** command determines the number of frame errors inserted into one frame.
ERRor INSert FRM SINgle	:Insert a single frame error into the data stream. If continuous errors are being inserted, this command can also stop the error insertion.
ERRor INSert FRM OFF	:Stop the frame error insertion.

See also: **FRM ERRor LENgth** and **FRM ERRor TYPe**

EXAMPLE:

>ERR INS FRM	:Print the current frame error insertion rate status.
OFF	:Frame error insertion rate is off.
>ERR INS FRM CONT	:Turn on the frame error insertion rate.
>ERR INS FRM SIN	:Insert a single frame error and end rate insertion.
OFF	
>	

 ERRor INSert LOGic

Logic Error Insertion

ERRor INSert LOGic [RATe | BURst | SINgle | OFF]

This command sets or prints the logic error insertion function.

ERRor INSert LOGic	:Print the current logic error insertion rate status.
ERRor INSert LOGic RATe	:Continuously insert logic errors into the data stream. The **ERRor RATe** command determines the insertion rate. The **ERRor INSert LOGic OFF** command disables the error insertion.
ERRor INSert LOGic BURst	:Insert a single burst of logic errors. The **ERRor RATe** command determines the insertion rate of the burst. The **BURst LENgth** command determines the burst duration. Note that an error message is printed when the burst length is set to 0 ms.
ERRor INSert LOGic SINgle	:Insert a single logic error. If continuous errors are being inserted, this command can also stop the error insertion.
ERRor INSert LOGic OFF	:Stop the insertion of logic errors.

See also: **ERRor RATe** and **BURst LENgth**

EXAMPLE:

>ERR INS LOG	:Print the current logic error insertion rate status.
OFF	:Logic insertion rate is off.
>ERR INS LOG RAT	:Turn on the continuous logic error insertion rate.
>ERR INS LOG SIN	:Insert a single logic error and end rate insertion.
>ERR INS LOG	:Print the current logic error insertion rate status.
OFF	
>	

ERRor RATe

ERRor RATe

BPV and Logic Error Insertion Rate

ERRor RATe [XX,y]

This command sets or prints the error rate for the logic error and BPV insertion functions.

ERRor RATe	:Print the current error insertion rate.
ERRor RATe XX,y	:Set a new error insertion rate. The error rate is entered in an XX,y format, and is interpreted as X.X E-y. The error insertion rate range is 1.0 E-2 (1,2) to 9.9 E-9 (99,9).

See also: **ERRor INSert BPV** and **ERRor INSert LOGic**

EXAMPLE:

>ERR RAT	:Print the current error insertion rate.
1.0 E-7	:The current error insertion rate is 1.0 E-7.
>ERR RAT 10,5	:Change the error insertion rate to 1.0 E-5.
>	

FIRST P.U.

FIRST P.U.

First Power-Up

FIRST P.U.	:This command resets NOVRAM to the factory default settings and initiates an autocalibration on the T-BERD 209A. Note that the T-BERD 209A is no longer in remote control mode after executing this command.

IMPORTANT: To continue beyond the reloading of NOVRAM, you must press the **RESTART** switch.

FORMAT **FORMAT**

Formatted Printouts

FORMAT :This command inserts spaces between words so that output from the T-BERD 209A is easy to read. The **FORMAT** command (as opposed to the **UNFORMAT** command) is the default for remote control mode; when the T-BERD 209A changes control mode (from local to remote or vice versa), the current setting remains unchanged.

See also: **UNFORMAT**

EXAMPLE 1:

```
>10 FORMAT                    :Set text to formatted mode.
>20 LPRINT THERE ARE BLANKS
>RUN
THERE ARE BLANKS              :Text is formatted with spaces.
>
```

EXAMPLE 2:

```
>10 UNFORMAT                  :Set text to unformatted mode.
>20 LPRINT THERE ARE NO BLANKS
>RUN
THEREARENOBLANKS              :Text is formatted without spaces.
>
```

 FRM ERRor LENgth

Frame Error Insertion Rate

FRM ERRor LENgth [1 | 2 | 3 | 4 | 5 | 6]

This command sets or prints the number of consecutive frame errors that are inserted when the **ERRor INSert FRM** command is executed.

FRM ERRor LENgth	:Print the current number of consecutive frame errors being inserted.
FRM ERRor LENgth [1 | 2 | 3 | 4 | 5 | 6]	:Set the number of consecutive frame errors from 1 to 6.

See also: **ERRor INSert FRM** and **FRM ERRor TYPe**

EXAMPLE:

>FRM ERR LEN	:Print the current number of consecutive frame errors being inserted.
4	:The current number of consecutive frame errors is 4.
>FRM ERR LEN 5	:Change the number of consecutive frame errors to 5.
>	

FRM ERRor TYPe **FRM ERRor TYPe**

ESFz Frame Error Type

FRM ERRor TYPe [FRM | ZBIt]

This command sets or prints the ESFz frame error type used when inserting frame errors into an ESFz formatted signal. This is only available when the Enhanced ESF Option is installed and does not affect other framing formats.

FRM ERRor TYPe :Print the current ESFz frame error type status.

FRM ERRor TYPe FRM :Insert frame errors into the Frame Alignment Signal (FAS) bit.

FRM ERRor TYPe ZBIt :Insert frame errors in the Z-bit of a ZBTSI encoded ESF signal.

See also: **FRM ERRor LENgth** and **ERRor INSert FRM**

EXAMPLE:

>FRM ERR TYP :Print the current ESFz frame error type status.
FRM
>FRM ERR TYP ZBIT :Change frame error type to Z-bit.
>FRM ERR TYP :Print the current ESFz frame error type status.
ZBIT
>

FT1 CHAnnel

FT1 CHAnnel

Set Fractional T1 Channel Bandwidth

FT1 CHAnnel [< SET | ADD | DEL hh hh ... > | PRInt]

This command provides the capability of entering, editing, and printing the FT1 channels. The following command parameters and format are required to establish the FT1 channels. The DS0 channel numbers can be entered in any order; the channel numbers are automatically sorted in memory. This command requires the Fractional T1 Option.

FT1 CHAnnel SET hh hh ...	:Enter two digit DS0 channel numbers in contiguous or noncontiguous order. The previous DS0 channel numbers are also deleted.
FT1 CHAnnel ADD hh hh ...	:Add channel numbers to the current channel numbers.
FT1 CHAnnel DEL hh hh ...	:Delete the current DS0 channel numbers.
FT1 CHAnnel PRInt	:Print the current DS0 channel numbers.

NOTE: Spaces or commas can be used to separate the channel numbers when entered.

See also: **FT1 IDLe** and **FT1 RATe**

EXAMPLE:

```
>FT1 CHA SET 01 02 03 04 05      :Enter contiguous channel numbers.
>FT1 CHA SET 03 02 04 01 05      :Enter contiguous channel numbers in random order.
>FT1 CHA PRI                     :Print the current DS0 channel numbers.
01 02 03 04 05
>
```

FT1 IDLe

FT1 IDLe

Set Fractional T1 Idle Code

FT1 IDLe [bbbbbbbb]

This command sets or prints the programmed FT1 idle code. This command requires the Fractional T1 Option.

FT1 IDLe	:Print the current FT1 idle code.
FT1 IDLe (bbbbbbbb)	:Set programmable 8-bit idle code. The idle code (**bbbbbbbb**) is an 8-bit binary pattern (a sequence of 1s and/or 0s) with the left-most bit transmitted first.

See also: **FT1 CHAnnel** and **FT1 RATe**

EXAMPLE:

```
>FT1 IDL                  :Print the current FT1 idle code.
01001001
>FT1 IDL 10011000         :Set the programmable idle code to 10011000.
>
```

Set Fractional T1 DS0 Data Rate

FT1 RATe [56 | 64]

This command sets or prints the FT1 DS0 data rate. This command requires the Fractional T1 Option.

FT1 RATe :Print the current DS0 data rate.

FT1 RATe 56 :Select the 56 kb/s DS0 channel rate.

FT1 RATe 64 :Select the 64 kb/s DS0 channel rate. The default data rate is 64xN.

See also: **FT1 CHAnnel** and **FT1 IDLe**

EXAMPLE:

```
>FT1 RAT                :Print the current DS0 data rate.
64
>FT1 RAT 56             :Select the 56 kb/s DS0 channel rate.
>
```

GOTO

GOTO

Transfer Program Execution to a Specified Line

GOTO [linenumber] :This command alters the sequence in which the T-BERD 209A executes commands in a BERD-BASIC program. When encountered in a running program, the **GOTO** command transfers execution to the command associated with the specified **linenumber** (as opposed to the next line in sequence).

EXAMPLE:

```
>10 LPRINT START HERE
>20 GOTO 40                    :Go to line 40.
>30 LPRINT THIS LINE IS NEVER PRINTED
>40 LPRINT JUMP TO HERE
>RUN
START HERE
JUMP TO HERE                   :Line 30 is skipped.
*DONE*
>
```

GRAph **GRAph**

Initiate a Graphic Printout

GRAph [PULse | TDR]

This command generates a printout of a pulse shape graph or TDR trace.

GRAph PULse :Generate a pulse shape graph.

GRAph TDR :Generate a TDR trace. This command is identical to the PRINT GRAPH function in the TDR RESULTS display. The **GRAph TDR** command is only available when the TDR Option is installed.

NOTE. The **GRAph** command should only be used when the remote controller has graphics capability.

See also: PULSE — **PLS MASk** and **TERM 232**.
TDR — **CABle, LENgth, MODe, PRInt, REFerence, RESTART, VELocity,** and **TERM 232**.

EXAMPLE:

>GRA PUL :Initiate a pulse shape printout.
> :Pulse shape printout starts.

> :Pulse shape printout is completed.

HELLO

HELLO

Display T-BERD 209A Software Revision Level

HELLO :This command prints the T-BERD 209A hardware and software revision levels, as well as any options that are included in the instrument.

EXAMPLE:

>HELLO :Print the hardware and software revision level.

```
T-BERD 209A
SW Rev. A
HW Rev. 010.
>
```

HELP HELP

On-Line Help Function

HELP [HELP | ! | <command-name> | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8]

This command provides access to the T-BERD 209A on-line help facility.

HELP :Display introductory help information.

HELP HELP :Display an index to all help information.

HELP! :Display all valid remote control commands.

HELP <command-name> :Display **command-name** syntax. This command defines and displays the command syntax for any specified remote control command. The following conventions apply:

1. Command parameters are presented as uppercase character strings (see Example 1).

2. Command and parameter summaries are preceded by three dashes (- - -) (see Examples 2 and 3).

HELP 1 :Display page 1, introductory help information.

HELP 2 :Display page 2, special characters.

HELP 3 :Display page 3, front-panel switch commands.

HELP 4 :Display page 4, auxiliary function commands, part one.

HELP 5 :Display page 5, auxiliary function commands, part two.

HELP 6 :Display page 6, special commands, part one.

HELP 7 :Display page 7, special commands, part two.

HELP 8 :Display page 8, BERD-BASIC commands.

On-Line Help Function (Continued)

EXAMPLE 1:

```
>HELP ERR INS BPV
OFF                    :These are the valid command parameters
RATE                   :for ERR INS BPV.
BURST
SIN
```

EXAMPLE 2:

```
>HELP CLO
HH,MM                  :These are the valid formats for the CLOck command.
HH.MM
HH/MM
HH;MM
HH:MM
HH-MM

- - -HH 0 TO 23 HOURS   :These are the valid ranges.
- - -MM 0 TO 59 MINUTES
```

EXAMPLE 3:

```
>HELP NEW              :Summarize the NEW command.
- - -ERASE THE EXISTING BASIC PROGRAM.

>
```

HIStory RESet

HIStory RESet

Reset Alarm History LED Indicators

HIStory RESet :This command resets all alarm history LEDs.

EXAMPLE:

>HIS RES :Clear the history LEDs.
>

HIStory CLR

HIStory CLR

Clear History and Printer Buffers

HIStory CLR :This command provides the ability to clear the history and print buffers.

EXAMPLE:

>HIS CLR :Clear history and printer buffers.
> :Buffers are cleared.

HOLD

HOLD

Hold All Printer Outputs

HOLD :This command temporarily holds all printer output (in the print buffer) until a **RELease** command is specified. Note that while the **HOLD** command is enabled, the prompt character changes from the standard "**>**" (or user-specified prompt) to a "**+**" to indicate that printer output is being held.

See also: **RELease**

EXAMPLE:

```
>HOL          :Hold all printouts for now ...
+CLO          : ... then print the time and date.
+DAT          :(note that nothing is printed)
+REL          :start printing ...
>             : ... and the prompt is changed back to ">".
12:34:56      :The T-BERD 209A prints the time ...
14 APR        : ... and date.
>
```

INPUT INPUT

Enter User Input Into a Macro

INPUT [m | m/prompt-string]

This command is used to enter user input into a macro. A macro is a string of characters that are defined once and recalled using one or two key strokes. When running a BERD-BASIC program with **INPUT** commands, the T-BERD 209A prompts you with a string (**INPUT m/prompt-string**) or a question mark (**INPUT m**). The parameter m is a number from 0 to 9. You can specify a response (to a maximum of 31 characters) which is stored as a macro.

INPUT m :Prompt user with a question mark.

INPUT m/prompt-string :Prompt user with string.

See also: **MACRO**

EXAMPLE:

```
>10 INPUT 2
>20 INPUT 3/TIME          :TIME is a prompt string for MACRO3.
>RUN
?PRINT BIT ERRORS         :Respond to "?" with PRINT BIT ERRORS.
TIME?PRINT CLOCK TIME     :Respond to prompt with PRINT CLOCK TIME.
*DONE*
>&2                       :Call MACRO 2 (PRINT BIT ERRORS).
1209A                     :Bit error results are displayed.
>&3                       :Call MACRO 3 (PRINT CLOCK).
11:22:33                  :The clock time is displayed.
>MACRO 2                  :Display the contents of MACRO 2.
PRINT BIT ERRORS
>MACRO 3                  :Display the contents of MACRO 3.
PRINT CLOCK TIME
>
```

LEDs **LEDs**

Display the State of Front-Panel LEDs

LEDs :This command displays the state of the T-BERD 209A alarm, status, and receive loop codes LEDs.

EXAMPLE:

>LED

```
                 — ALARMS —              — STATUS —
ON     OFF    SIGNAL LOSS    OFF    T1 PULSES
ON     OFF    PATTERN LOSS   ON     T1C PULSES
OFF    OFF    FRAME LOSS     ON     PATTERN SYNC
OFF    OFF    ONES DENSITY   OFF    FRAME SYNC
ON     OFF    EXCESS ZEROS   OFF    B8ZS
OFF    OFF    YELLOW ALARM
OFF    OFF    ALL ONES
OFF    OFF    PULSE SHAPE
OFF    OFF    LOW BATTERY
OFF    OFF    POWER LOSS

—— RECEIVE LOOP CODES
OFF    PRE-EXIST LOOP
OFF    LOOP UP
OFF    LOOP DOWN
>
```

LENgth **LENgth**

Select TDR Cable Length

LENgth [1k | 3k | 6k | AUTO]

This command sets or prints the TDR cable length being tested.

LENgth	:Print the current TDR cable length.
LENgth 1k	:Select cable length of 1000 feet.
LENgth 3k	:Select cable length of 3000 feet.
LENgth 6k	:Select cable length of 6000 feet.
LENgth AUTO	:Tests to the first fault or up to 6500 feet if no faults are detected.

See also: **CABle, GRAph, MODe, PRInt, REFerence, RESTART,** and **VELocity**

EXAMPLE:

```
>LEN                    :Print the current TDR cable length.
1k
>LEN AUTO               :Set cable length to AUTO mode.
>
```

LIST

List the Working BERD-BASIC Program

LIST [linenumber]

This command lists the contents of the currently active BERD-BASIC program in ascending numerical order, and displays the number of unused bytes in program memory. If a line number is not specified, the listing starts with the first line of the program; otherwise, the listing starts with the specified line number.

LIST :List the entire program.

LIST linenumber :List program starting with specified **linenumber**.

EXAMPLE:

```
>10 CLOCK          :Enter CLOCK as line 10.
>30 DATE           :Enter DATE as line 30.
>20 CLS            :Enter CLS as line 20.
>LIST              :List current program.

10 CLOCK
20 CLS
30 DATE
[489 BYTES FREE]
>
```

LOCal

LOCal

Return the T-BERD 209A to Local Mode

LOCal or / (slash) :This command returns the T-BERD 209A to local front-panel control from remote control or terminal mode. In local mode, all front-panel switches are active regardless of the display mode. The T-BERD 209A remains in local mode until **REMOTE**, **TERMINAL**, period (**.**), or another valid command is entered from the remote control device. When Local mode is specified, note that the remote control unit is disabled if the baud rate settings of the remote control unit and the T-BERD 209A do not match.

See also: **PROmpt, ECHo, DISplay, REMOTE,** and **TERMINAL**

EXAMPLE:

>LOC	:Enter local (front panel) mode ...
REMOTE	: ... then return to remote control mode.
/	:Quickly return to local mode (prompt and echo are not enabled).

LOOp

Select ESF Loop Code Type

LOOp [IN | OUT]

This command sets or prints the ESF loop code type: in-band or out-of-band. The **LOOp** command also determines which loop code type the T-BERD 209A responds to (see **RESPONSE** command). The **LOOp** command is only used when testing ESF or ESFz, FT1 ESF, or FT1 ESFz formatted circuits (see **MODe** command). The loop code is selected with the **LOOp CODe** command.

LOOp	:Print the current ESF loop code type.
LOOp IN	:Select the ESF in-band loop codes.
LOOp OUT	:Select the ESF out-of-band loop codes.

See also: **LOOp CODe, LOOp DOWn, LOOp UP, RESPONSE, PGM LPUp,** and **PGM LPDn**

EXAMPLE:

>LOO	:Print the current ESF loop code type.
OUT	:The current loop code type is out-of-band.
>LOO IN	:Select the ESF in-band loop codes.
>LOO	:Print the current ESF loop code type.
IN	
>	

LOOp DOWn

Generate Loop-Down Code

LOOp DOWn [ON | OFF]

This command sets or prints the transmission of the selected loop-down code.

LOOp DOWn :Print the current transmission status of loop-down code.

LOOp DOWn ON :Enable the loop-down code transmission. The transmission of the loop-down code continues until it is no longer detected or until the **LOOp DOWn OFF** command is issued.

LOOp DOWn OFF :Disable the loop-down code transmission.

See also: **LEDs, LOOp CODe, LOOp, LOOp UP, RESPONSE, PGM LPUp,** and **PGM LPDn**

EXAMPLE:

>LOO DOW :Print the current transmission status of loop-down code.
OFF
>LOO DOW ON :Enable the loop-down code transmission.
>

LOOp UP

LOOp UP

Generate Loop-Up Code

LOOp UP [ON | OFF]

This command sets or prints the transmission of the selected loop-up code.

LOOp UP	:Print the current transmission status of loop-up code.
LOOp UP ON	:Enable the loop-up code transmission. The transmission of the loop-up code continues until it is detected for 250 ms, or until the **LOOp UP OFF** command is issued.
LOOp UP OFF	:Disable the loop-up code transmission.

See also: **LEDs, LOOp CODe, LOOp, LOOp DOWn, RESPONSE, PGM LPUp,** and **PGM LPDn**

EXAMPLE:

>LOO UP	:Print the current transmission status of loop-up code.
OFF	
>LOO UP ON	:Enable the loop-up code transmission.
>	

LOOp CODe LOOp CODe

Select Loop Code Pattern

LOOp CODe [CSU | FAC1 | FAC2 | PGM | LINe | NETwork | PAYload]

This command sets or prints the loop code pattern. The **LOOp CODe** command also determines which loop code the T-BERD 209A responds to (see **RESPONSE** command).

LOOp CODe :Print the current loop code pattern selection.

LOOp CODe CSU :Select the in-band CSU loop code pattern.

LOOp CODe FAC1 :Select the in-band facility 1 loop code pattern.

LOOp CODe FAC2 :Select the in-band facility 2 loop code pattern.

LOOp CODe PGM :Select the in-band user-programmed loop code pattern. Program the loop codes with the **PGM LPDn** and **PGM LPUp** commands.

The following commands only apply to the T1 ESF, T1 ESFz, FT1 ESF, or FT1 ESFz operating mode. Select the loop code type with the **LOOp OUT** command.

LOOp CODe LINe :Select the out-of-band line loop code pattern.

LOOp CODe NETwork :Select the out-of-band network loop code pattern.

LOOp CODe PAYload :Select the out-of-band payload loop code pattern.

See also: **LOOp, LOOp DOWn, LOOp UP, RESPONSE, PGM LPUp**, and **PGM LPDn**

EXAMPLE:

```
>LOO COD                :Print the current loop code pattern selection.
CSU
>LOO COD PGM            :Select user-programmable loop code.
>
```

LPRINT

LPRINT

Print a Literal Text String

LPRINT string :This command sends a text string during the execution of a BERD-BASIC program. If the string is surrounded by double quotes, printing is inhibited for any succeeding string in the program line. If quotes do not surround the string, any consecutive number of spaces in the string are condensed to one space.

EXAMPLE:

```
>10 LPRINT "HELLO" THAT'S ALL
>20 LPRINT HI  I'M  LARRY
>30 LPRINT "I  HAVE  MORE  SPACES"
>RUN

HELLO                          :Words after second quote are omitted.
HI I'M LARRY                   :Spaces condensed (no quotes).
I  HAVE  MORE  SPACES          :Spaces not condensed (quotes).
*DONE*
>
```

LUP

LUP

Enter/Modify Long User Pattern

LUP [SET hh hh ... | APPend hh hh ... | REPlace pp hh hh ... | INSert pp hh hh ... | DELete pp dd | SIZe | PRInt pp dd]

This command provides the capability of entering, editing, deleting, and printing the long user pattern. This command requires the Advanced BERT Option.

LUP SET hh hh ...	:Enter hexadecimal characters (**hh** = 00H to FFH), up to 100 characters at a time.
LUP APP hh hh ...	:Append pattern by adding characters to the end of the message.
LUP REP pp hh hh ...	:Replace portions of pattern starting at position **pp**.
LUP INS pp hh hh ...	:Insert new characters into pattern starting at position **pp**.
LUP DEL pp dd	:Delete a specific number of bytes **dd** from the message starting at position **pp**.
LUP SIZe	:Print the number of characters in the message.
LUP PRInt pp dd	:Print **dd** bytes of the message starting at position **pp.** Without **pp** and **dd** entered, the entire message is printed. With **pp** and no **dd**, the message is printed from **pp** to end of message.

NOTE: **hh** is a 1-byte hexadecimal number from 00H to FFH. **pp** and **dd** are integers from 1 to 2000.

See also: **PATtern**

EXAMPLE:

```
>LUP SET 00 01 00 ...      :Enter the pattern 00H, 01H, 00H ...
>
```

MACRO

MACRO

Set or Display User Macros

MACRO [number | number/ | number/string]

This command displays and defines macros used to enter commands. A macro is a string of characters that are defined once and recalled using only one or two key strokes. Typically, they are used when a given command may need to be entered many times.

Macros are recalled by specifying an ampersand (&) followed by the macro number whenever the macro substitution takes place. Note that, although the **INPUT** command is also used to define a macro, it can only be used in a BERD-BASIC program; the **MACRO** command has no such restriction.

MACRO	:Print all currently defined macros.
MACRO number	:Display specified macro number from 0 to 9.
MACRO number/	:Clear specified macro number.
MACRO number/string	:Define specified macro number as a string from 1 to 80 characters in length.

See also: **INPUT**

EXAMPLE:

```
>MACRO 1/CLOCK          :Define macro 1 as CLOCK.
>MACRO 2/DATE           :Define macro 2 as DATE.
>&1                     :Display the current time of day.
20:07:13
>&1 21:08               :Set the time ahead one hour (TIME 21:08).
>&2                     :Display the current date (DATE).
15 JAN
>MACRO 2                :Display the contents of MACRO 2.
DATE
>
```

MESsages MESsages

Enable or Disable Error Message Printing

MESsages [ON | OFF]

This command sets or prints the error messages sent to the remote control device.

MESsages :Print current status for printing error messages.

MESsages ON :Enable the printing of error messages when the appropriate conditions exist. This command is the default at power-up.

MESsages OFF :Disable the printing of error messages under such conditions.

EXAMPLE:

>MES :Print current status of error message printing.
OFF
>MES ON :Enable the printing of error messages.
>

MODe

MODe

Transmit and Receive Mode

MODe [AUTo | FT1 D4 | FT1 ESF | FT1 ESFZ | SEL TST | T1 | T1 D4 | T1 ESF | T1 ESFZ | T1 LLB | T1 SLC | T1 TLB | T1C | T1C TLB | TDR]

This command sets or prints the transmit and receive line rate and data format.

MODe :Print the current transmit and receive line rate and data format.

MODe AUTo :Select the automatic configuration mode.

MODe FT1 D4 :Select the D4 superframe fractional T1 mode. Requires the Fractional T1 Option.

MODe FT1 ESF :Select the Extended superframe fractional T1 mode. Requires the Fractional T1 Option.

MODe FT1 ESFZ :Select the ZBTSI encoded ESF fractional T1 mode. Requires the Fractional T1 Option.

MODe SEL TST :Select the Self-Test mode using T1 ESF.

MODe T1 :Select the T1 line rate unframed.

MODe T1 D4 :Select the T1 rate with D4 framing.

MODe T1 ESF :Select the T1 rate with ESF framing.

MODe T1 ESFZ :Select the T1 rate with ZBTSI encoded ESF framing. Requires the Enhanced ESF Option.

MODe T1 LLB :Select the T1 rate in Line Loopback mode.

MODe T1 SLC :Select the T1 rate with SLC-96 framing.

MODe T1 TLB :Select the T1 rate in Test Loopback mode.

MODe T1C :Select the T1C line rate unframed.

Transmit and Receive Mode (Continued)

MODe T1C TLB :Select the T1C rate in Test Loopback mode.

MODe TDR :Configure as a Time Domain Reflectometer. Requires the TDR Option.

NOTE The auxiliary functions are selected and modified using separate commands.

EXAMPLE:

See also: Fractional T1 Option — **FT1 CHAnnel, FT1 IDLe,** and **FT1 RATe**.
Enhanced ESF Option — **PRM EMUlate** and **PRM RCV**.
TDR Option — **CABle, LENgth, MODe, PRInt, REFerence, RESTART, VELocity,** and **TERM 232**.

>MOD :Print the current transmit and receive line rate and data format.

T1 SLC
>MOD T1 ESF :Set the mode to the T1 rate with ESF framing.
>

NEW **NEW**

Enter a New BERD-BASIC Program

NEW :This command clears the working memory of any BERD-BASIC program. It is used when entering a new program to ensure that no lines are left from a previous program. When this command is specified, 511 bytes of memory are freed for the new program.

EXAMPLE:

```
>10 INPUT 2
>20 DATE
>LIST
>
10 INPUT 2
20 DATE
[493 BYTES FREE]
>NEW                    :Purge the existing program.
>LIST
>
[511 BYTES FREE]
```

PARity **PARity**

Display Current Parity Setting

PARity :This command prints the current T-BERD 209A parity setting. Note that this is an inquire-only command; you cannot change the parity setting through remote control.

EXAMPLE:

>PARity :Print the current parity setting.
EVEN
>PARity ODD :Try to set odd parity.
ERROR: PARITY IS NOT AN EXECUTABLE COMMAND
>

PATtern **PATtern**

Set Test Pattern

PATtern [1:1 | 1:7 | 2 IN 8 | 2^15-1 | 2^20-1 | 2^23-1 | 3 IN 24 | 55 OCTet | ALL ONES | ALL ZERO | BRIDGTAP | LUP | MIN/MAX | MULTIPAT | T1 DALy | T1-2/96 | T1-3/54 | T1-4/120 | T1-5/53 | T1-QRSS | T1C-QRSS | USER1 | USER2]

This command sets or prints the test pattern generated by the T-BERD 209A.

PATtern :Print current test pattern status.

PATtern 1:1 :Select the alternating ones and zeros pattern.

PATtern 1:7 :Select the one and seven zeros pattern.

PATtern 2 IN 8 :Select the two ones in 8-bits pattern.

PATtern 2^15-1 :Select the 32,767-bit pseudorandom pattern.

PATtern 2^20-1 :Select the 1,048,575-bit pseudorandom pattern.

PATtern 2^23-1 :Select the 8,388,607-bit pseudorandom pattern.

PATtern 3 IN 24 :Select the three ones in 24-bits pattern.

PATtern 55 OCTet :Select the 55 OCTET test pattern. Requires the Advanced BERT Option.

PATtern ALL ONEs :Select the all ones pattern.

PATtern ALL ZERo :Select the all zeros pattern.

PATtern BRIDGTAP :Select the bridge tap detection test pattern.

PATtern LUP :Select the programmable long user pattern. Program the pattern with the **LUP** command. Requires the Advanced BERT Option.

PATtern MIN/MAX :Select the minimum/maximum stress test pattern. Requires the Advanced BERT Option.

PATtern MULTIPAT :Select the multipattern test pattern.

Set Test Pattern (Continued)

PATtern T1 DALy :Select the T1 DALY test pattern. Requires the Advanced BERT Option.

PATtern T1-2/96 :Select the T1-2/96 test pattern. Requires the Advanced BERT Option.

PATtern T1-3/54 :Select the T1-3/54 test pattern. Requires the Advanced BERT Option.

PATtern T1-4/120 :Select the T1-4/120 test pattern. Requires the Advanced BERT Option.

PATtern T1-5/53 :Select the T1-5/53 test pattern. Requires the Advanced BERT Option.

PATtern T1-QRSS :Select the T1 Quasi-Random Signal Source pattern.

PATtern T1C-QRSS :Select the T1C Quasi-Random Signal Source pattern.

PATtern USER1 :Select the User 1 programmable 3- to 24-Bit pattern. Program the bit pattern and pattern name with the **PGMPAT 1** command.

PATtern USER2 :Select the User 2 programmable 3- to 24-Bit pattern. Program the bit pattern and pattern name with the **PGMPAT 2** command.

See also: **PGMPAT 1, PGMPAT 2,** and **LUP**

EXAMPLE:

```
>PAT                    :Print current test pattern status.
T1-QRSS
>PAT 2^15-1             :Select the new pattern.
>
```

PGM LPDn **PGM LPDn**

Program Loop-Down Code

PGM LPDn [bbb | bbbb to bbbbbbbb]

This command sets or prints the in-band programmable loop-down code. Select the loop code with the **LOOp CODe PGM** command. Transmit the loop code with the **LOOp DOWn ON** command. The command also determines which loop code the T-BERD 209A responds to (see **RESPONSE** command).

PGM LPDn :Print the in-band programmable loop-down code.

PGM LPDn bbbbb..b :Set in-band programmable loop-down sequence. The loop-down code sequence is a 3- to 8-bit binary pattern (a sequence of 1s and/or 0s) with the left-most bit transmitted first.

See also: **LOOp CODe, LOOp, LOOp DOWn, LOOp UP, RESPONSE,** and **PGM LPUp**

EXAMPLE:

>PGM LPD :Print the in-band programmable loop-down code.
01001001
>PGM LPD 100 :Set programmable loop-down code to 100.
>

PGM LPUp **PGM LPUp**

Program Loop-Up Code

PGM LPUp [bbb | bbbb to bbbbbbbb]

This command sets or prints the in-band programmable loop-up code. Select the loop code with the **LOOp CODe PGM** command. Transmit the loop code with the **LOOp UP ON** command. The command also determines which loop code the T-BERD 209A responds to (see **RESPONSE** command).

PGM LPUp	:Print the in-band programmable loop-up code.
PGM LPUp bbbbb..b	:Set in-band programmable loop-up sequence. The loop-up code sequence is a 3- to 8-bit binary pattern (a sequence of 1s and/or 0s) with the left-most bit transmitted first.

See also: **LOOp CODe, LOOp, LOOp DOWn, LOOp UP, RESPONSE,** and **PGM LPDn.**

EXAMPLE:

>PGM LPU	:Print the in-band programmable loop-up code.
01001001	
>PGM LPU 100	:Set programmable loop-up code to 100.
>	

PGMPAT 1 AND 2

PGMPAT 1 AND 2

Programmable Data Pattern

PGMPAT [< 1 | 2 > | yyyyyyy,bbb...b]

This command sets or prints the USER1 and USER2 test patterns and changes the pattern name. The programmed pattern is selected and transmitted with the **PATtern** command. The user-defined label and pattern are stored in nonvolatile memory.

PGMPAT 1	:Print the current programmable data pattern 1.
PGMPAT 2	:Print the current programmable data pattern 2.
PGMPAT [1 | 2] bbb...b	:Set programmable data pattern bit sequence. The data pattern (**bbb...b**) can be a 3- to 24-bit binary pattern (a sequence of ones and/or zeros); when generated, the left-most bit is transmitted first. The default PGMPAT 1 bit pattern is 1000000 (1:6). The default PGMPAT 2 bit pattern is 100000 (1:5).
PGMPAT [1 | 2] yyyyyy	:Set programmable data pattern name. The USER1 and USER2 names can be changed by entering a name with a maximum of seven alphanumeric characters (**yyyyyy**). Specifying a new name is optional when programming a bit sequence. However, if a name is specified, it will appear in the PATTERN window when front-panel control is returned to the T-BERD 209A.The PGMPAT 1 default name is USER1 and the PGMPAT 2 default name is USER2.
PGMPAT [1 | 2] yyyyyy,bbb...b	:Set programmable data pattern name (**yyyyyy**) and bit sequence (**bbb...b**).

See also: **PATtern**

PGMPAT 1 AND 2

Programmable Data Pattern (Continued)

EXAMPLE:

```
>PGMPAT 1                                  :Print the current programmable data pattern 1.
USER1   1000000                            :This is the default name and bit sequence.
>PGMPAT 1 TESTIT, 101011100000000111010
                                           :Select the name and bit sequence.
>PGMPAT 1, 11010101110000                  :Select the bit sequence and retain the name.
>
```

PRInt **PRInt**

Initiate Printout

PRInt [CONtrols | RESults | SUMmary]

This command generates either a controls, results, or summary printout.

PRInt CONtrols :Generate a controls printout.

PRInt RESults :Generate a results printout.

PRInt SUMmary :Generate a SUMMARY category results printout.

NOTE: In the optional TDR mode, only the **PRInt CONtrols** and **PRInt RESults** commands are available to print controls and results printouts.

Initiate Printout (Continued)

EXAMPLE:

>PRI RES :Generate a results printout.

```
  RESULTS PRINT          15:47:20       30 APR
BIT ERR                0  ASYN E SEC          0
BER              0 E-07   EFS                 40
%EFS            100.00%   SY ERR SEC          0
OUT SY SEC             0  SLIPS               0
SES                    0  %SES             00.00%
DEGR MIN               0  %DEGR MIN        00.00%
UNAVL SEC              0  %AVL            100.00%
CSES                   0  BPV ERR             0
BPV ER SEC             0  BPV RATE        0 E-07
FRA ER SEC             0  FRA ERR             0
F E RATE               0  E-06  CRC ERR       0
CRC ER SEC             0  FRA LOS             0
FRA LS SEC             0  CRC SES             0
CRC E RT         0 E-06   FREQ Hz       1544000
RX LVL       - 0.2dBdsx   RX VOLT    5.85 V p-p
SPX CUR     UNDER 10mA    TIMING SLIPS       *0
BIT SLIPS          +  0   SLP ANA SEC        40
SIG LS SC              0  ALARM SEC           0
TEST LEN      200:00:00   ELAP TIM     00:00:00
TEST END            ****  WANDER +PK       0 UI
WANDER -PK           0 UI P-P WANDER        0 UI
TIE WANDER           0 UI

     ALARM/STATUS
T1                    ON   PATTERN SYNC       ON
FRAME SYNC            ON
```

PRInt

PRInt

Initiate Printout (Continued)

>PRI CON :Generate a controls printout.

```
  CONTROLS PRINT          16:13:03    27 OCT
MODE:          SELF TEST   PATTERN:     ALL ONES
TIMED/CONT:        TIMED   DIS HOLD:         OFF
TIMING:              INT   CODE:            AMI
ERR INS BPV:         OFF   ERR INS LOG:     OFF
ERR INS FRM:         OFF   RCV INPUT:      TERM
TX LBO:              0dB   PRI EVNT:        OFF
LP CD SELECT:CSU LP UP     CD:            10000
LP DN CD:             100  RESPONSE:     NO AUTO
PARITY:              NONE  BAUD RATE:      2400
CR/CR-LF:              CR  FORMAT:        SHORT
INS RATE:1.0 E-6 BURST     LNGTH:           0mS
FRM ERR:           SINGLE  PULSE SEL:      NONE
HALT/CONT:           HALT
```

>PRI SUM :Generate a SUMMARY category results printout.
. :Summary print follows.
.
.
>

Display a Single Result Value

PRINT [result name | result number]

This command displays the value of the indicated test result on the remote control device. Unlike the **RES 1** and **RES 2** commands, the front panel does not change to the specified result.

PRINT result name :Select the result by name and print the test result value.

PRINT result number :Select the result by number and print the test result value.

NOTE: Printing Result 22 lists all of the CRC bins.

The valid **result names** and **result numbers** are listed below.

LOGIC Category — Mainframe

00 - BIT ERRORS	:Bit errors
01 - ASYN ER SEC	:Asynchronous Error Seconds
04 - BIT ERR RT	:Bit error rate
05 - ER FREE SEC	:Error-free seconds
06 - %EFS	:% Error-free seconds
07 - SYN ERR SEC	:Synchronized error seconds
08 - OUT SYN SEC	:Out-of-synchronization seconds
09 - SLIPS	:Pattern slips

LOGIC Category — G.821 Performance Analysis Option

10 - SEV ERR SEC	:Severely errored seconds
11 - %SEV ER SEC	:% Severely errored seconds
12 - DEGR MIN	:Degraded minutes
13 - %DEGR MIN	:% Degraded minutes
14 - UNAVL SEC	:Unavailable seconds
15 - %AVLBILITY	:% Availability
16 - CSES	:Consecutive severely errored seconds

BPV & FRAME Category — Enhanced ESF Option

17 - FAR FRM ES	:Far-End Frame Error Seconds
18 - FAR FRM SES	:Far-End Severely Errored Framing Seconds
19 - FAR BPV SEC	:Far-End BPV Seconds
20 - FAR SLP SEC	:Far-End Controlled Slip Seconds
21 - FAR PRM SEC	:Far-End Performance Report Seconds
22 - FAR CRC ERR	:Far-End CRC Error Events
23 - PAY SRC	:Far-End Payload Source/Loopback

PRINT PRINT

Display a Single Result Value (Continued)

BPV & FRAME Category — Mainframe

25 - VIOLATIONS	:Violations
26 - BPV SECONDS	:BPV seconds
27 - BPV RATE	:BPV rate
28 - FRM ERR SEC	:Frame errored seconds
29 - FRM SES	:Frame severely errored seconds
30 - FRM ERRORS	:Frame errors
31 - FRM ER RATE	:Frame error rate
32 - CRC ERRORS	:CRC errors
33 - CRC ERR SEC	:CRC errored seconds
34 - FRM LOS CNT	:Frame loss count
35 - FRM LOS SEC	:Frame loss seconds
36 - CRC SES	:CRC severely errored seconds
37 - CRC ERR RT	:CRC error rate

SIGNAL Category — Mainframe

40 - RX FREQ, Hz	:Receive frequency in Hz
41 - RX LEVEL (dBdsx)	:Receive level in dBdsx
42 - RX LEVEL (dBm)	:Receive level in dBm
43 - RX LEVEL (Vp-p)	:Receive level in volts
44 - PULSE SHAPE	:Pulse shape
45 - PULSE WIDTH	:Pulse width
46 - RISE TIME	:Pulse rise time
47 - FALL TIME	:Pulse fall time
48 - UNDERSHOOT	:Undershoot
49 - OVERSHOOT	:Overshoot
50 - SPX CURRENT	:Simplex current
51 - TIMING SLIP	:Controlled timing slips
53 - SLP ANA SEC	:Timing slip analysis seconds

TIME Category — Mainframe

60 - SIG LOS SEC	:Signal loss seconds
61 - ALARMED SEC	:Alarmed second
62 - TEST LENGTH	:Length of a timed test
63 - ELAPSE TIME	:Elapsed time
64 - TEST END IN	:Time remaining in timed test
65 - CLOCK TIME	:Clock time of day
66 - DATE	:Date

Display a Single Result Value (Continued)

WANDER Category — Mainframe

70 - WANDER +PK	:Maximum positive wander peak
71 - WANDER -PK	:Maximum negative wander peak
72 - P-P WANDER	:Peak-to-peak wander
73 - 15m WANDER	:Maximum peak-to-peak wander over 15 minutes
74 - 24h WANDER	:Maximum peak-to-peak wander over 24 hours
75 - TIE WANDER	:Tie wander

See also: **RES 1** and **RES 2**

EXAMPLE:

```
>PRINT SLIPS                    :Print the number of pattern slips.
SLIPS 23
>
```

PRInt EVEnt **PRInt EVEnt**

Print Event

PRInt EVEnt [OFF | END TESt | ERRors | SEV ERR SEC | 2HR | 15M | TIMe h:mm]

This command determines when (if at all) the T-BERD 209A generates automatic test result printouts. Any setting other than the **PRInt EVEnt OFF** command enables automatic results printouts when one or more alarm conditions change.

PRInt EVEnt	:Print the current print event status.
PRInt EVEnt OFF	:Halt results printouts and clear the printer FIFO.
PRInt EVEnt END TESt	:Print results at end of test.
PRInt EVEnt ERRors	:Print results on logic, BPV, or frame error.
PRInt EVEnt SEV ERR SEC	:Print results on severely errored second.
PRInt EVEnt 2HR	:Print results every two hours.
PRInt EVEnt 15M	:Print results every 15 minutes.
PRInt EVEnt TIMe h:mm	:Print results at the time interval specified. The colon symbol (:) may be replaced by a dash (-), comma (,), period (.), or slash (/). The valid range for **h** (hours) is 0 to 5. The valid range for **mm** (minutes) is 0 to 59. This command is only available in remote control mode.

EXAMPLE:

>PRI EVE	:Print the current print event status.
OFF	
>PRI EVE 15M	:Print results every 15 minutes.
>	

PRM EMUlate **PRM EMUlate**

Set PRM Transmission Control

PRM EMUlate [CARrier | CUStomer | OFF]

This command sets or prints the PRM transmission control emulation.

PRM EMUlate	:Print the status of PRM transmission control.
PRM EMUlate CARrier	:Set the transmitted PRM to emulate a carrier transmitted PRM (PRM C/R Bit = 1).
PRM EMUlate CUStomer	:Set the transmitted PRM to emulate a customer transmitted PRM (PRM C/R Bit = 0).
PRM EMUlate OFF	:Disable the PRM transmission capability.

See also: **PRM RCV**

EXAMPLE:

>PRM EMU	:Print the status of PRM transmission control.
CAR	:Transmitting the carrier PRM.
>PRM EMU OFF	:Turn the PRM off.
>	

PRInt FMT

Results Print Format

PRInt FMT [NORmal | SHOrt | SUMmary]

This command sets or prints the results printout format.

PRInt FMT	:Print the current results printout format.
PRInt FMT NORmal	:Provide a printout of all the results.
PRInt FMT SHOrt	:Provide only those results which are specifically applicable to the current mode, plus the two results currently displayed on the front panel.
PRInt FMT SUMmary	:Provide all results in the SUMMARY category.

EXAMPLE:

>PRI FMT :Print the current results printout format.
SHORT
>PRI FMT NOR :Provide a printout of all the results.
>

PRM RCV

PRM Results Analysis Control

PRM RCV [ON | OFF]

This command controls the PRM results displayed in the BPV & FRAME category.

PRM RCV	:Print the status of the PRM results analysis control.
PRM RCV ON	:Enable the ability to report on the received PRM.
PRM RCV OFF	:Disable the PRM results.

See also: **PRM EMUlate**

EXAMPLE:

>PRM RCV	:Print the status of the PRM results analysis control.
ON	:PRM results are enabled.
>PRM RCV OFF	:Disable the PRM results.
>	

PROmpt **PROmpt**

Remote Control Command Prompt

PROmpt [ON | OFF | STRING prompt-string]

This command controls the prompt symbol at the remote control unit.

PROmpt	:Print the status of the prompt.
PROmpt ON	:Enable the "**>**" as the prompt symbol when the T-BERD 209A is ready to receive a command.
PROmpt OFF	:Turn off the prompt symbol.
PROmpt STRING prompt-string	:Define a **prompt-string**.

NOTE: The prompt symbol changes to a "+" when the **HOLD** command is specified.

EXAMPLE:

>PRO	:Print the status of the prompt.
ON	
>PRO STRING =	:Define the **prompt-string** as an "**=**" symbol.
=PRO OFF	:Turn off the "**=**" prompt.
CLOCK	:Print the time (no prompt).
10:33:04	
PRO ON	:Turn on the "**=**" prompt.
=	

Pulse Mask Specification

PULse MASk [NI | DSX | NONe]

This command sets or prints the pulse mask specification selection.

PULse MASk	:Print the current pulse mask specification.
PULse MASk NI	:Select the Bell T1.403 Network Interface pulse mask specification.
PULse MASk DSX	:Select the AT&T Compatibility Bulletin 119 pulse mask specification.
PULse MASk NONe	:No pulse mask specification is selected; no mask appears on the pulse shape printout.

EXAMPLE:

>PUL MAS	:Print the current pulse mask specification.
NET INT	:The Network Interface is selected.
>PUL MAS DSX	:Select the DSX pulse mask.
>	

PWR SAVe

PWR SAVe

Battery Power Save Control

PWR SAVe [ON | OFF]

This command sets or prints the battery power save control function.

PWR SAVe	:Print the current battery power save control function.
PWR SAVe ON	:Enable the battery power save control function.
PWR SAVe OFF	:Disable the battery power save control function.

EXAMPLE:

>PUL MAS	:Print the current pulse mask specification.
NET INT	:The Network Interface is selected.
>PUL MAS DSX	:Select the DSX pulse mask.
>	

Receive Input

RECeive INPut [BRIdge | TERminated | DSX]

This command sets or prints the input impedance and signal conditioning. Also note that this command causes a test restart.

RECeive INPut	:Print the current receive input status.
RECeive INPut BRIdge	:Set the receive input for a bridged input. This provides an input impedance greater than 1000 ohms for lines already terminated.
RECeive INPut TER	:Set the receive input for a terminated input. This provides 100 ohms impedance.
RECeive INPut DSX	:Set the receive input for a DSX-level input. This provides both 100 ohms impedance and amplification of the signal.

EXAMPLE:

>REC INP	:Print the current receive input status.
DSX	
>REC INP TER	:Set the receive input for a terminated input.
>	

REFerence

REFerence

Select TDR Reference Trace

REFerence [STOre | CLEar]

This command sets or prints the TDR reference trace condition.

REFerence :Print the current TDR reference trace status.

REFerence STOre :Store the current TDR trace results in memory. Any succeeding PRINT GRAPHs will print with the reference trace and the current trace. This command performs the same function as pressing the **RESULTS II Category** switch with NO REF displayed in the TDR SETUP menu or pressing the same switch twice with REF STORED displayed.

REFerence CLEar :Clear the reference trace from memory. Any succeeding PRINT GRAPHs will only print the current trace. This command performs the same function as pressing the **RESULTS II Category** switch with REF STORED displayed in the TDR SETUP menu.

See also: **CABle, GRAph, LENgth, MODe, PRInt, RESTART,** and **VELocity**.

EXAMPLE:

>REF :Print the current TDR reference trace status.
STORE
>REF CLEAR :Clear the reference trace from memory.
>

RELease RELease

Release All Printer Output

RELease :This command releases all output in the print buffer from the **HOLd** command. When the **RELease** command is specified, the prompt character changes from the "**+**" to the standard "**>**" (or user-specified prompt) to indicate that the printer output is no longer held.

See also: **HOLD**

EXAMPLE:

```
>HOLD          :Hold all printouts for now ...
+CLO           : ... then print the time and date
+DAT           :(note that nothing is printed).
+REL           :Release the print buffer and start printing ...
>              : ... and the prompt changes to ">".
12:34:56       :The T-BERD 209A prints the time ...
14 APR         : ... and date.
>
```

REMark **REMark**

Remark or Comment

REMark :This command is used to place a remark or comment in a BERD-BASIC program. Remarks are nonexecutable, and thus ignored by the T-BERD 209A.

EXAMPLE:

```
>10 LPRINT LOOSE LIPS
>20 REM SHOULD BE TIGHTENED?      :This line is a remark and is ignored.
>30 LPRINT SINK SHIPS
>RUN

LOOSE LIPS                        :Line 20 is nonexecutable.
SINK SHIPS
>
```

REMOTE **REMOTE**

Remote Control Entry

REMOTE :This command places the T-BERD 209A in remote control mode from either local or terminal mode. In remote control mode, all front-panel switches are inactive (except for the **RESULTS** switches). Unlike the **TERMINAL** command, the **REMOTE** command turns the prompt and echo off.

See also: **LOCal, PROmpt, ECHo,** and **TERMINAL**

EXAMPLE:

REMOTE :Enter remote control mode from local mode.
:Enable prompt and echo as required.

RES 1 and 2

RES 1 and 2

Result Display Control

RES 1 or 2 [result name | result number]

These commands control the display results on the T-BERD 209A front panel. Unlike the **PRINT** command, the front panel is updated to reflect the result specified; additionally, the value of the specified result is not displayed at the remote control device.

RES 1 result name	:Select the result by name and display the test result in the RESULTS I window.
RES 2 result name	:Select the result by name and display the test result in the RESULTS II window.
RES 1 result number	:Select the result by number and display the test result in the RESULTS I window.
RES 2 result number	:Select the result by number and display the test result in the RESULTS I window.

Refer to the **PRINT** command for a list of valid **result names** and **result numbers.**

See also: **PRINT**

EXAMPLE:

>RES 1 66	:Display the 66 - DATE result in the RESULTS I window.
>RES 2 35	:Display the 35 - FRM LOS SEC result in the RESULTS II window.

>

RESPONSE RESPONSE

T-BERD 209A Loop Code Response

RESPONSE [AUTO | NONE]

This command controls how the T-BERD 209A responds to loop codes.

RESPONSE :Print the current loop code response status.

RESPONSE AUTo :Set the T-BERD 209A to respond to loop codes by emulating a CSU. If five seconds of an in-band loop-up code are received, the T-BERD 209A automatically enters AUTO LLB mode; and the instrument repeats all transmitted data until a valid loop-down code is sent. After receiving a loop-down code, the T-BERD 209A exits AUTO LLB mode and reenters the mode indicated by the current setting of the **MODe** command.

RESPONSE NONe :Set the T-BERD 209A to remain in its current mode when detecting a loop code.

See also: **LOOp, LOOp DOWn, LOOp UP, LOOp CODe, PGM LPUp,** and **PGM LPDn**

EXAMPLE:

>RESPONSE :Print the current loop code response status.
NONE
>RESPONSE AUT :Set for automatic loop code response.
>

RESTART

RESTART

Test Restart

RESTART :This command performs a test restart on the T-BERD 209A. It also starts the TDR testing when the **MODe TDR** command is selected.

EXAMPLE:

>RESTART :Restart the test. All test results are cleared, the alarm LEDs are cleared, and all timers are reset.

>

RESULTS RESULTS

Generate a Results Printout

RESULTS :This command generates a results printout of the current T-BERD 209A test results. This command is identical to the **PRInt RESults** command.

See also: **PRInt RESults**

EXAMPLE:

>RESULTS :Generates a results printout.

```
  RESULTS PRINT          15:47:20        30 APR
BIT ERR                0  ASYN E SEC           0
BER              0 E-07   EFS                  40
%EFS            100.00%   SY ERR SEC           0
OUT SY SEC             0  SLIPS                0
SES                    0  %SES             00.00%
DEGR MIN               0  %DEGR MIN        00.00%
UNAVL SEC              0  %AVL            100.00%
CSES                   0  BPV ERR              0
BPV ER SEC             0  BPV RATE         0 E-07
FRA ER SEC             0  FRA ERR              0
F E RATE               0  E-06  CRC ERR        0
CRC ER SEC             0  FRA LOS              0
FRA LS SEC             0  CRC SES              0
CRC E RT         0 E-06   FREQ Hz        1544000
RX LVL       - 0.2dBdsx   RX VOLT     5.85 V p-p
SPX CUR      UNDER 10mA   TIMING SLIPS        *0
BIT SLIPS          +  0   SLP ANA SEC         40
SIG LS SC              0  ALARM SEC           0
TEST LEN      200:00:00   ELAP TIM      00:00:00
TEST END           ****   WANDER +PK        0 UI
WANDER -PK         0 UI   P-P WANDER        0 UI
TIE WANDER         0 UI

    ALARM/STATUS
T1                    ON   PATTERN SYNC     ON
FRAME SYNC            ON

>
```

RUN **RUN**

Execute a BERD-BASIC Program

RUN [linenumber]

This command executes a BERD-BASIC program.

RUN :Execute the entire BERD-BASIC program.

RUN linenumber :Execute the BERD-BASIC program beginning at the specified **linenumber**.

EXAMPLE:

```
>10 LPRINT FRANKLIN
>20 LPRINT DELANO
>30 LPRINT ROOSEVELT
>RUN 30                 :Execute the program starting at line 30.
ROOSEVELT               :Only line 30 is executed.
>RUN                    :Execute the entire program.
FRANKLIN
DELANO
ROOSEVELT
>
```

STOP

STOP

Suspend Execution of a BERD-BASIC Program

STOP :This command suspends the execution of a running BERD-BASIC program; execution of a BERD-BASIC program is resumed by issuing the **CONT** command. Program execution cannot be resumed if any existing line in a program has been changed, or if a program has reached its conclusion.

See also: **CONT**

EXAMPLE:

```
>10 LPRINT "FIRST HALF"        :This program runs in two halves ...
>20 STOP                       : ...with a STOP in the middle.
>30 LPRINT "SECOND HALF"
>40 END
>RUN                           :Run the program.
FIRST HALF                     :The program stops running ...
BREAK IN LINE 20               : ...due to the STOP command.
>CONT                          :Continue running the program.
SECOND HALF
*DONE*                         :The program is finished running.
>
```

SUMmary **SUMmary**

Generates a Summary Printout

SUMmary :This command generates a summary results printout. This command is identical to the **PRInt SUM** command.

EXAMPLE:

>SUM :Generates a summary results printout.
. :Summary printout follows
.
.
> :Summary print ends.

SYNc LOSs ACTion **SYNc LOSs ACTion**

Action on Synchronization Loss

SYNc LOSs ACTion [CONT | HALT]

This command sets or prints the action on synchronization loss function.

SYNc LOSs ACTion	:Print the current action on synchronization loss function status.
SYNc LOSs ACTion CONT	:Set action on synchronization loss to continuous. This causes all test results to accumulate continuously throughout a loss of synchronization.
SYNc LOSs ACTion HALT	:Set action on synchronization loss to halt. This causes test results to halt accumulation during a loss of synchronization.

EXAMPLE:

>SYN LOS ACT	:Print the current action on synchronization loss function status.
HALT	:The T-BERD 209A is in the HALT mode.
>SYN LOS ACT CONT	:Set action on sync loss to CONT.
>	

TERM 232

TERM 232

Remote Control Line Terminator

TERM 232 [CR | CRLF]

This command sets or prints the RS-232 line termination character(s).

TERM 232	:Print the current line terminator character(s).
TERM 232 CR	:Set the line terminator character to a carriage return.
TERM 232 CRLF	:Set the line terminator characters to a carriage return and a linefeed.

EXAMPLE:

>TERM 232	:Print the current line terminator character(s).
CRLF	
>TERM 232 CR	:Set the line terminator character to a carriage return.
>	

TERMINAL

TERMINAL

Configure the T-BERD 209A for Remote Control Operation

TERMINAL or . (period)

This command places the T-BERD 209A in terminal mode from either local or remote mode. In terminal mode, all front-panel switches are inactive (except for the **RESULTS** switches). Unlike the **REMOTE** command, the **TERMINAL** command automatically sets the following conditions:

ECHo ON	:Turn echo on.
PROmpt ON	:Turn prompts on.
WIDTH 80	:Set printer width for 80 columns.
TERM 232 CRLF	:Set line terminator to carriage return and linefeed.

This command is typically used as a log-in sequence just after the T-BERD 209A is powered up. You need only type a period (.) to get the T-BERD 209A's attention, enter terminal mode, and have the default prompt (>) printed on the screen.

See also: **ECHo, PROmpt, TERM 232, LOCal,** and **REMOTE**

EXAMPLE:

:Assume the T-BERD 209A has just powered up; type a period (.) which the T-BERD 209A does not echo.

> :The T-BERD 209A responds with a prompt and is now in terminal mode.

TEST

TEST

Test Results Accumulation

TEST [TIMED | CONT]

This command sets or prints the test duration criteria for accumulating test results.

TEST	:Print the current test duration criteria.
TEST TIMED	:Set the test duration for a timed test. The duration is set with the **TIMe SET** command.
TEST CONT	:Set the test duration for a continuous test.

See also: **TIMe SET**

EXAMPLE:

```
>TEST                    :Print the current test duration criteria.
CONT
>TEST TIMED              :Set the test duration for a timed test.
>
```

Transmit Timing Source

TIMing [EXTernal | INTernal | RECovered]

This command sets or prints the transmit timing source.

TIMing	:Print the current transmit timing source.
TIMing EXTernal	:Set the transmit timing to either the T1 REF jack or the EXT CLK IN connector.
TIMing INTernal	:Set the transmit timing to the internal clock source.
TIMing RECovered	:Set the transmit timing source to the recovered clock signal from the received data.

EXAMPLE:

>TIM	:Print the current transmit timing source.
INT	:The transmit timing source is internal.
>TIM REC	:Change the transmit timing source to recovered.
>	

TIMe SET

Test Length

TIMe SET [HHH:MM:SS]

This command sets or prints the test length for a timed test.

TIMe SET :Print the current test length setting.

TIMe SET HHH:MM:SS :Set the new test length in hours (HHH), minutes (MM), and seconds (SS). The colon (:) may be replaced by a dash (-), comma (,), period (.), semicolon (;), or slash (/). The valid ranges for each time value are:

HHH	:0 to 200 hours
MM	:0 to 59 minutes
SS	:0 to 59 seconds

See also: **TEST**

EXAMPLE:

```
>TIM SET                :Print the current test length setting.
12:35:00                :The current test length is 12 hours. 35 min.
>TIM SET ; 6 ;          :Set the test length for 6 minutes.
>
```

TRAnsmit OUTput **TRAnsmit OUTput**

Transmit Output

TRAnsmit OUTput [-7.5 | 0 | -15]

This command sets or prints the transmit output level.

TRAnsmit OUTput	:Print the current transmit output level.
TRAnsmit OUTput -7.5	:Set the transmit output for -7.5 dBdsx.
TRAnsmit OUTput 0	:Set the transmit output for 0.0 dBdsx.
TRAnsmit OUTput -15	:Set the transmit output for -15.0 dBdsx.

EXAMPLE:

```
>TRA OUT                    :Print the current transmit output level.
-7.5 (dB)
>TRA OUT -15                :Set the transmit output for -15.0 dBdsx.
>
```

UNFORMAT **UNFORMAT**

Unformatted Printouts

UNFORMAT :This command suppresses printing spaces between words in the printed output. The alternative is the **FORMAT** command, which inserts the spaces to make printouts easier to read.

See also: **FORMAT**

EXAMPLE 1:

```
>10 FORMAT                    :Set to print the spaces.
>20 LPRINT THERE ARE BLANKS
>RUN
THERE ARE BLANKS              :Printed as indicated in line 20.
```

EXAMPLE 2:

```
>10 UNFORMAT                  :Set to print without the spaces.
>20 LPRINT THERE ARE NO BLANKS
>RUN
THEREARENOBLANKS              :Printed without the spaces in line 20.
```

VELocity **VELocity**

Select User Selected TDR Propagation Velocity

VELocity [0.40 to 0.99]

This command sets or prints the TDR USER propagation velocity (PR. VEL).

VELocity	:Print the current TDR propagation velocity.
VELocity 0.40 to 0.99	:Set the TDR PR. VEL from 0.40 to 0.99 in 0.01 steps. Setting this command automatically places the CABLE type in the previous USER selection (see **CABle** command). This command is identical to the USER PR. VEL function in the TDR SETUP menu. The default PR. VEL is 0.66.

See also: **CABle, GRAph, LENgth, MODe, PRInt, REFerence,** and **RESTART.**

EXAMPLE:

>VEL	:Print the current TDR propagation velocity.
0.46	
>VEL 0.75	:Set the TDR PR. VEL to 0.75.
>	

SECTION 9 SPECIFICATIONS

SPECIFICATIONS

9.1 INTRODUCTION

This section contains the specifications for the T-BERD 209A T-Carrier Analyzer mainframe and options.

9.2 MAINFRAME — GENERAL SPECIFICATIONS

9.2.1 Physical

Size:	6.0"H x 13.5"W x 8.5"D (15.3 cm x 34.4 cm x 16.5 cm) including cover.
Weight:	Without battery — 10 pounds (4.5 kg).
	With battery — 15.7 pounds (7.1 kg).

9.2.2 Operational

Operating Temperature Range:	32°F to 113°F (0°C to 45°C).
Storage Temperature Range:	-4°F to 158°F (-20°C to 70°C).
Power:	115 VAC or 230 VAC (factory option only), ±10%, 50/60 Hz.
Fuse:	1 A, 250 V Slo-Blo (Littlefuse #218001 or equivalent).

9.3 MAINFRAME — INPUT SPECIFICATIONS

9.3.1 Receive Input

Input Connectors: WECO 310 jack, bantam jack, and 15-pin network interface D connector.

Input Frequency: T1 — 1,544,000 Hz ±5000 Hz.

T1C — 3,152,000 Hz ±5000 Hz.

Input Impedance: BRIDGE — 1000 ohms or greater.

TERM — 100 ohms ±5%.

DSX-MON — 100 ohms ±5%.

Operating Range: BRIDGE — T1: +6 dBdsx to -35 dBdsx.
T1C: +3 dBdsx to -6 dBdsx.
(ALBO compensates for cable loss.)

TERM — T1: +6 dBdsx to -35 dBdsx.
T1C: +3 dBdsx to -6 dBdsx.
(ALBO compensates for cable loss.)

DSX-MON — T1 or T1C: +6 dBdsx to -24 dBdsx.
No ALBO provided; resistive loss compensation only.

9.3.2 T1 REF (TDR) Input

Input Connectors: WECO 310 and bantam jacks.

Input Frequency: 1,544,000 Hz ±1000 Hz.

Input Impedance: 100 ohms ±5%.

Operating Range: +6 to -24 dBdsx resistive loss.

9.4 MAINFRAME — OUTPUT SPECIFICATIONS

Output Connectors:	Selectable line build-out in T1 of 0 dB, -7.5 dB, and -15 dB is provided on WECO 310 jack, bantam jack, and 15-pin network interface D connector. Three additional DSX-level 310 jack outputs are provided.
Output Line Build-out Tolerance:	±1 dB attenuation at 772 kHz.
Pulse Shape:	With output terminated in 100 ohm resistive load and 0 dB line build-out selected, the T-BERD 209A meets CCITT Recommendation G.703; AT&T Publications CB113, CB119, CB132, CB143, and PUB62508; and AT&T PUB62411 pulse shape specifications.
Internal Oscillator Accuracy:	±5 ppm.
Jitter Attenuation:	Per Figure A-5 of AT&T PUB62411, October 1985 Revision.
Line Codes:	Bipolar (pseudoternary); AMI, B8ZS, or ZBTSI (optional) selectable.

9.5 MAINFRAME — ALARM CRITERIA

Signal Loss:	150 ms without input pulses after valid frequency and level are detected.
Pattern Sync Loss:	250 errors detected in 1000 or fewer bits.
Frame Sync Loss:	D4 — 2 out of 5 Ft bits in error. ESF (ESFz) — 2 out of 5 frame bits in error. SLC — 2 out of 5 Ft bits in error.

Excess Zeros:	T1 — AMI: 16 consecutive zeros. B8ZS: 8 consecutive zeros. T1C — 34 consecutive zeros.
Yellow Alarm:	D4 — Bit 2 is a 0 for 255 consecutive channels. ESF — 256 bits ±16 bits of a repetitive (1111 1111 0000 0000 ...) pattern received in the 4 kb/s datalink. SLC — Bit 2 is a 0 for 255 consecutive channels.
All Ones:	T1 or T1C unframed — 2048 consecutive ones. T1 framed — 256 consecutive DS0 channels with all ones.
Ones Density:	Less than n ones in 8(n+1) bits, where n = 1 to 23 per AT&T PUB62411 and ANSI T1.403. Disabled when receiving a T1-QRSS pattern or any T1C signal.
Pulse Shape:	Received pulse shape exceeds selected pulse shape mask specification.
Low Battery:	Approximately 15 minutes of battery life remaining.

9.6 MAINFRAME — PATTERN SYNC DETECTION CRITERIA

Fixed Patterns:	30 consecutive error-free bits.
Pseudorandom Patterns:	30 + n consecutive error-free bits for a pattern length of 2n-1. For QRSS, n = 20.

9.7 MAINFRAME — LOOP CODES

9.7.1 Generation and Detection Patterns

In-band Loop Codes:	CSU — Loop up: 10000; loop down: 100.
	Facility 1 — Loop up: 1100; loop down: 1110.
	Facility 2 — Loop up: 11000; loop down: 11100.
	Programmable — 3- to 8-bit repeating code independently selectable for loop-up and loop-down codes. Factory default: loop up — 10000 (CSU loop-up); loop down — 100 (CSU loop-down).
ESF Out-of-Band Loop Codes:	LINE — Loop up: 1111 1111 0111 0000; loop down: 1111 1111 0001 1100.
	PAYLOAD — Loop up: 1111 1111 0010 1000; loop down: 1111 1111 0100 1100.
	NETWORK — Loop up: 1111 1111 0100 1000; loop down: 1111 1111 0010 0100.

NOTE: Generated codes may be sent unframed or framed. When framing is selected, in-band loop codes are overwritten by the framing bit.

9.7.2 Loop Code Detect Criteria

In-band Loop Codes:	At least 185 error-free bits of the selected repetitive pattern must be received (Loop Up and Loop Down).
ESF Out-of-Band Loop Codes:	Datalink monitored every 125 ms for loop codes (Loop Up and Loop Down).

9.8 MAINFRAME — MEASUREMENTS

9.8.1 Frequency

Accuracy:	±5 ppm.
Resolution:	1 Hz.
T1 Range:	1,544,000 Hz ±5000 Hz.
T1C Range:	3,152,000 Hz ±5000 Hz.

9.8.2 Level

The designation dBdsx is a voltage measurement; a 3-volt base-to-peak signal is defined as 0 dBdsx. Measurements for dBm are available only when all ones is detected.

dBdsx Level Range:	+6 dBdsx to -40 dBdsx.
dBdsx Level Accuracy:	±1 dB between +6 dBdsx and -10 dBdsx. ±2 dB between -10 dBdsx and -20 dBdsx. ±3 dB between -20 dBdsx and -40 dBdsx.
dBdsx Resolution:	0.1 dB between +6 dBdsx and -6 dBdsx. 0.5 dB between -6 dBdsx and -40 dBdsx.
dBm Level Range:	+22.5 dBm to -23.5 dBm.
dBm Level:	±5%.
dBm Resolution:	0.1 dB between +22.5 dBm and +10.5 dBm. 0.5 dB between +10.5 dBm and -23.5 dB.
Vp-p Range:	60 mV to 12.0 V.

9.8.3 Simplex Current

Range:	10 mA to 180 mA.
Resolution:	1 mA.
Accuracy:	±5%.
Simplex Voltage Drop:	8.5 volts (nominal) at 60 mA.

9.8.4 Pulse Shape

Sample Interval:	2.75 ns.
Analysis Interval:	648 ns from rising edge of pulse.
Availability:	TERM & BRIDGE — +4 to -4 dBdsx.
	DSX-MON — -16 to -24 dBdsx.
Horizontal Accuracy:	±5%.
Vertical Accuracy:	±8%.
Resolution:	Pulse Width — 2.75 ns.
	Rise Time — 1 ns.
	Fall Time — 1 ns.
	Undershoot — 1%.
	Overshoot — 1%.

9.8.5 Timing Slips

Resolution:	1 frame slip.
Range:	0 to 9999 frame slips.
Bar Graph Resolution:	16 bit slips.
Bar Graph Range:	±192 bit slips.
Wheel Resolution:	1 bit slip.
Wheel Range:	±16 bit slips.
Frame Slip Printout Resolution:	1 frame slip.
Frame Slip Printout Range:	0 to 9999 frame slips.
Bit Slip Printout Resolution:	1 bit slip.
Bit Slip Printout Range:	±192 bit slips.
Slip Analysis Seconds Resolution:	1 second.
Slip Analysis Seconds Range:	0 to 99999999 seconds.

9.8.6 Wander

Resolution:	1 UI.
Accuracy:	1 UI.

9.9 MAINFRAME — CONNECTORS

9.9.1 EXT CLK IN

Connector:	BNC.
Input Configuration:	AC-coupled. Outer conductor is signal ground; inner conductor is signal.
AC Input Impedance:	50 ohms ±10%.
Sine-Wave Clock Waveform:	5 Vp-p minimum; 10 Vp-p maximum. 1.0 MHz minimum; 4.0 MHz maximum.
Square-Wave Clock Waveform:	1 Vp-p minimum; 20 Vp-p maximum. 1.0 MHz minimum; 4.0 MHz maximum.

9.9.2 Network Interface

Connector Pin Configuration:	See Table 9-1.

Table 9-1
Network Interface Pin Assignments

Pin	Name
1	TRANSMIT TIP
2, 4, 12	SIGNAL GROUND
3	RECEIVE TIP
5, 6, 7, 8, 10	NO CONNECTION
9	TRANSMIT RING
11	RECEIVE RING
13	RESERVED FOR FUTURE USE
14	RESERVED FOR FUTURE USE
15	+5 VDC

9.9.3 RS-232 25-Pin D Connector

Character Format:	7 (odd or even parity) or 8 (no parity) data bits (ASCII characters). 2 transmitted stop bits. Accepts 1 or more received stop bits.
Baud Rates:	300, 1200, 2400, 4800. (110, 600, 9600, and 19200 baud rates are available in autobaud mode only.)
Line Terminator:	CR or CRLF.
Print Width:	80 column.
Connector Configuration:	DCE.
Connector Pin Assignments:	See Table 9-2.

9.10 MAINFRAME — GROUNDING

Chassis and Signal Grounds:	Isolated by 100 ohm, 1/2 watt resistor.
Bantam and WECO 310 Jacks:	Sleeves connected to chassis ground.
Power Cord:	Center pin connected to chassis ground.
RS-232 25-pin D connector:	Pin 1 to chassis ground. Pin 7 to signal ground.
Network Interface 15-pin D Connector:	Pins 2, 4, and 12 to signal ground.

Table 9-2
RS-232 Pin Assignments

Pin	Designation	Description
1	FGND	Frame ground — connected to chassis ground.
2	TD	Transmit data — The T-BERD 209A receives data on this lead.
3	RD	Receive data — Data is transmitted by the T-BERD 209A on this lead.
4	RTS	Request to Send — This lead is terminated by the T-BERD 209A.
5	CTS	Clear to Send — This lead is driven to the ON state by the T-BERD 209A whenever it is ready to receive a command. This lead may be ignored by the controller if, before issuing commands, it waits for the return of a prompt character from the T-BERD 209A signifying the completion of the previous command.
6	DSR	Data Set Ready — This lead is driven to the ON state by the T-BERD 209A whenever it has power applied.
7	SGND	Signal Ground — Connected to signal ground.
8	RLSD	Receive Line Signal Detect — Must be ON before the T-BERD 209A will accept any data.
9	+V	+12 VDC.
10	-V	-12 VDC.
20	DTR	Data Terminal Ready — Data is only output from the T-BERD 209A when this line is held in the ON condition by the receiving device.

9.11 BATTERY OPTION SPECIFICATIONS

Type:	Gelled lead-acid electrolyte.
Operating Period:	Without T1 Channel Monitor — Up to 5 hours.
	With T1 Channel Monitor — Up to 3 hours.
Storage Period:	@ 68°F, holds 85% of charge after 6 months. Requires recharging every 6 months.
Recharging Period:	8 hours from full discharge.

9.12 T-BERD T1 CHANNEL MONITOR OPTION SPECIFICATIONS

9.12.1 General Characteristics

Size:	13.5" L x 6" W x 2.8" D (34.3 cm x 15.2 cm x 7.1 cm).
Weight:	6.5 pounds (2.9 kg).
Operating Temperature:	0°C to 40°C (32°F to 113°F).
Operating Humidity:	90% Maximum non-condensing.
Storage Temperature Range:	-20°C to 70°C (-4°F to 158°F).
Storage Humidity:	5% to 95% non-condensing.
Input Power:	Supplied through coiled interface cable from T-BERD 209A.

9.12.2 Input Specifications

Input Connector:	Supplied through the coiled interface cable from the T-BERD 209A.
Framing Formats:	ESF, SLC, D3/D4, D2, and D1D.

9.12.3 Output Specifications

Signaling Status:	4 x 24 LED array displays the status of the channel signaling bits.
VF Outputs:	600 ohm WECO 310 jack and speaker.
VF Level:	-54 dBm to +3 dBm in 3 dBm steps

9.12.4 RS-232 Interface

Connector:	RS-232 25-pin D connector.
Pin Assignments:	See Table 9-3.
Signal Outputs:	DS0 channel, SLC-96 datalink, or T1 ESF datalink.
Signal Input:	T1 ESF datalink.

Table 9-3
T1 Channel Monitor Option RS-232 Pin Assignments

Pin	Signal	Direction	Comments
1	PROT GND	—	Connected to chassis ground.
2	TD	IN	The T1 Channel Monitor receives data on this lead (ESF mode only).
3	RD	OUT	Data is transmitted on this lead; data is present when ESF, SLC, or CHANNEL is selected, and frame synchronization is achieved.
4	RTS	IN	This lead must be active to insert data.
5	CTS	OUT	This lead is active when RTS is active.
6	DSR	OUT	This lead is ON when power is applied.
7	SIGNAL GROUND	—	Connected to signal ground.
8	RLSD	OUT	This lead is ON when ESF, SLC, or CHANNEL is selected, and frame synchronization is achieved.
15	TX CLK	OUT	Synchronizes transmit data for datalink insert (4 kHz).
17	RX CLK	OUT	Clock for receive data (4 kHz).

9.13 T-BERD REPEATER POWER SUPPLY OPTION SPECIFICATIONS

9.13.1 Physical Characteristics

Size:	13.5" L x 6" W x 2.8" D (34.3 cm x 15.2 cm x 7.1 cm).
Weight:	6.5 pounds (2.9 kg).

9.13.2 Operational Requirements

Operating Temperature:	0°C to 40°C (32°F to 113°F).
Operating Humidity:	90% Maximum non-condensing.
Storage Temperature Range:	-20°C to 70°C (-4°F to 158°F).
Storage Humidity:	5% to 95% non-condensing.

9.13.3 Power Requirements

Input:	115 VAC ±10%, 60 Hz ±10%.
Fuse:	1-amp fast blow fuse (1 A AGC 3).

9.13.4 Safety Features

High Voltage Indicator:	On when voltage or current is applied to circuit.
Pulsed Current Mode:	On when circuit current is below 40 mA.
Constant Current Mode:	On when circuit current is above 40 mA.

Pulsed Current to Continuous Current Delay:	5 seconds nominal.
Continuous Current to Pulsed Current Delay:	2 seconds nominal.
Pulse Rate:	1.25 Hz nominal.
Pulse Duration:	10 ms.
Crossbar:	A 350 VDC crowbar circuit prevents runaway conditions due to loss of feedback.

9.13.5 Regulatory Compliance

Complies with UL1459, Telephone Equipment, 1st and 2nd Editions.

Complies with IEEE STD-743.

9.13.6 Connections

T1 Span: Dual WECO 310 or dual bantam tip-to-tip connectors.

Mainframe Interface: 15-pin D connector.

Pin Assignments:

Pin Number	Pin Name
1	Transmit Tip
2, 4, 12	N/C
3	Receive Tip
5, 6, 7, 8, 10	N/C
9	Transmit Ring
11	Receive Ring
13, 14, 15	Reserved

9.13.7 Output Specifications

Repeater Power Current: 60 mA, 100 mA, 140 mA selectable ±5%.

Open Circuit Voltage:	260 VDC nominal, 350 VDC maximum.
Operating Voltage:	Determined by the load.

9.13.8 Measurements

Voltage Meter Accuracy:	0 - 399 VDC ±5%.
Current Meter Accuracy:	0 - 399 mA ±5%.

9.14 TIME DOMAIN REFLECTOMETER OPTION SPECIFICATIONS

Connection:	Jack type — WECO 310 or bantam. Impedance — 167 ohms ±2%. Isolation Voltage Protection — 1000 Vmax.
Pulse Repetition Rate:	11.718 kHz, nominal.
Pulse Amplitude:	10.0 Vp, nominal.
Vertical Dynamic Range:	60 dB, minimum.
Resolution:	<9 feet.
Time Base Accuracy:	0.05%.
Test Range:	100 to 6500 ft. for identified faults and distance. 0 to 10,500 ft. for TDR trace printout.
Acquisition Time:	12 sec. average.
Data Presentation:	Front panel display or printer.

9.15 T-BERD DLC ANALYZER OPTION SPECIFICATIONS

This section lists the specifications of the T-BERD DLC Analyzer Option.

9.15.1 General Specifications

Size:	6.0"H x 13.5"W x 2.5"D (15.3 cm x 34.3 cm x 6.4 cm).
Weight:	5 pounds (2.3 kg).
Operating Temperature Range:	32°F to 122°F (0°C to 50°C).
Storage Temperature Range:	-4°F to 158°F (-20°C to 70°C).
Power:	7 watts, maximum (power supplied by T-BERD209A).

9.15.2 T1 Input Specifications

Input Connectors:	WECO 310 jacks for primary and secondary receivers.
Input Frequency:	1,544,000 Hz ±4000 Hz.
Input Impedance:	BRIDGE — 1000 ohms or greater.
	TERM — 100 ohms ±5%.
	DSX-MON — 100 ohms ±5%.
Input Signal Range:	BRIDGE — +6 dBdsx to -35 dBdsx (ALBO compensation for cable loss).
	TERM — +6 dBdsx to -35 dBdsx (ALBO compensation for cable loss).
	DSX-MON — +6 dBdsx to -24 dBdsx (resistive loss compensation only).
Framing Formats:	SLC Mode 1, SLC Mode 2, T1 D1D, T1 D4, T1 ESF, and Auto framing.

9.15.3 T1 Output Specifications

Output Connector:	WECO 310 jack.
Output Line Build-out:	0 dB, -7.5 dB, and -15 dB.
Pulse Shape:	With output terminated in 100 ohm resistive load and 0 dB line build-out selected, the T-BERD DLC Analyzer meets ANSI T1.403 pulse shape specifications.
Line Code:	AMI or B8ZS selectable.

9.15.4 VF Drop

VF Drop Sources:	Primary receiver, secondary receiver, or both receivers.
VF Drop Interfaces:	Built-in speaker, 2-terminal 2-wire VF interface, and WECO 310 4-wire VF interface.
VF Measurements:	VF level — -40 dBm to +3 dBm.
	VF frequency — in Hertz.
	DTMF sequence — displayed numerical values.

9.15.5 VF Insert

VF Insert Sources:	Internally generated tones — 404 Hz, 1004 Hz, and 2804 Hz.
	External input — 2-terminal 2-wire interface.
VF Tone Levels:	-16 dBm, -10 dBm, -3 dBm, 0 dBm, and +3 dBm.

9.15.6 Trunk Control

SLC Trunk Type:	Ground start and loop start.
Signal Controls:	A, B, C, and D signaling, and on-hook, off-hook, and ringing signaling.

9.15.7 SLC Transmitted Messages

SLC Alarms:	Major, Minor, Power/Misc, Far-End Loop, Switch to Protection, and Shelf Alarm.
SLC Maintenance:	Maintenance Proceed, Maintenance Hook/Seize, and Maintenance Test Alarm.

9.15.8 Test Results

SUMMARY Category:	Violations, frame errors, and CRC errors (ESF only) — Displayed with errors greater than zero.
DATALINK Category:	Alarms, maintenance, SLC alarmed seconds, datalink bits, and alarm field — Detected in the datalink channel.
CHANNEL Category:	Traffic channel ABCD signaling, Traffic timeslot ABCD signaling, VF level, VF frequency, data bits, and DTMF sequence.
TIME Category:	Signal loss seconds, time, and date.

APPENDIX A
FACTORY DEFAULT SETTINGS

FACTORY DEFAULT SETTINGS

A.1 T-BERD 209A MAINFRAME FACTORY DEFAULT SETTINGS

This appendix identifies the T-BERD 209A factory default settings for the switch positions and auxiliary functions that are stored in nonvolatile memory. To configure the T-BERD 209A with the factory default settings, press the RESTART switch then apply power. Release the **RESTART** switch after power is applied. When the message *LOAD NOVRAM* appears, press **RESTART** again. Table A-1 lists the factory default settings.

Table A-1
T-BERD 209A Factory Default Settings

Front Panel Switches	Default
MODE	SELF TST
PATTERN	ALL ONES
TIMING	INT
TEST	TIMED
CODE	AMI
PRINT EVENT	OFF
RESULTS I and II	SUMMARY
ERROR INSERT	OFF
RESTART	OFF
DISPLAY HOLD	OFF
RECEIVE INPUT	TERM
TRANSMIT OUTPUT	0dB(DSX)
LOOP CODES	OFF
Auxiliary Functions	**Default**
Mainframe	
AUX USER1	1000000 (1:6)
AUX USER2	100000 (1:5)
AUX RESPONSE	NO RESPONSE
AUX PGM LPUP	10000

Table A-1
T-BERD 209A Factory Default Settings (Continued)

Auxiliary Function	Default
Mainframe	
AUX PGM	LPDN100
AUX BAUD	2400 bps
AUX PARITY	NONE
AUX HALT/CONT	HALT
AUX PRNT FMT	SHORT FORMAT
AUX TERM	CR
AUX PLS MASK	NONE
AUX RES HIST	NO RESULT PRNT EVNT AVAILABLE
AUX HIST CLR	EMPTY
AUX ERR SEL	SINGLE ERROR
AUX FRM ERR, FRM ERR INS	SINGLE ERROR
AUX ER RATE	1.0 E-6
AUX CLOCK	Current time
AUX DATE	Current month and day
AUX TEST LEN	200:00:00
AUX GRAPH	N/A
AUX LP CODE, IN BAND	CSU
AUX LP CODE, OUT OF BAND	LINE
AUX ESF LOOP	IN BAND
Battery Option	
AUX PWR SAVE	OFF
Advanced BERT Option	
AUX LUP	MIN/MAX pattern
Fractional T1 Option	
AUX FT1 CHAN	01
AUX FT1 SETUP, IDLE	11111111
AUX FT1 SETUP, CHAN RATE	64 X N

Table A-1
T-BERD 209A Factory Default Settings (Continued)

Enhanced ESF Option	
AUX FRM ERR, T1 ESFz	FRM-BIT ERR
AUX PRM, PRM TRANSMIT	OFF
AUX PRM, PRM RCVR	ON
TDR Option	
CABLE	DEFAULT
PR. VEL	.66
LENGTH	AUTO

A.2 T-BERD DLC ANALYZER FACTORY DEFAULT SETTINGS

This appendix also identifies the T-BERD DLC Analyzer Option factory default settings for the switch positions and auxiliary functions that are stored in nonvolatile memory. To configure the T-BERD DLC Analyzer Option with the factory default settings, press the **RESTART** switch then apply power. Release the **RESTART** switch after power is applied. When the message *LOAD NOVRAM* appears, press **RESTART** again. Table A-2 lists the factory default settings.

Table A-2
T-BERD DLC Analyzer Factory Default Settings

Front Panel Switches	Default
CODE	AMI
FRAME	SLC-M1
FORMAT	CHANNEL
SOURCE I	1004Hz
SOURCE II	0dB
RESULTS I and II	SUMMARY
RESTART	N/A
DISPLAY LIGHT	OFF
PRINT	OFF
RECEIVE INPUTS	DSX-MON
PRIMARY CHANNEL	— —
SECONDARY CHANNEL	— —
INSERT	OFF
SIGNALING INSERT	All OFF
Auxiliary Functions	**Default**
CHANNEL/VF DROP	BOTH
CHANNEL/CHANNEL SCROLL	BOTH
CHANNEL/TRUNK TYPE	LOOP START
TRANSMIT/LBO	0dB
TIME/SET TIME	(Time of software release)
TIME/SET DATE	(Date of software release)

APPENDIX B
OPERATING MESSAGES

OPERATING MESSAGES

B.1 INTRODUCTION

This appendix lists the printed messages; the messages that appear on the front panel; and error and warning messages generated during local and remote control operation.

B.2 PRINTED MESSAGES

These messages are generated automatically when an important condition occurs. The **PRINT EVENT** switch must be set to a selection other than OFF to generate these messages. The alarm message includes the date, time, and message.

ALL ONES — Indicates whether the All Ones LED is ON or OFF.

BUFFER FULL — Indicates that the print buffer has overflowed. Note that this is the only message that is not date- and time-stamped.

NOTE: Print buffer overflow may result in lost information.

EX ZERO — Indicates whether the Excess Zeros LED is ON or OFF. This message is not applicable with the 2^20-1 or 2^23-1 pattern.

FRA SYNC ACQUIRED — Indicates frame synchronization is acquired.

FRAM LOSS — Indicates frame synchronization is lost, followed by a count of the number of such occurrences during the test.

LOOP DN DURA — Indicates the number of seconds from the time loop-down code starts until it stops.

LOOP DOWN DETECT — Indicates that the loop-down code is detected.

LOOP DOWN LOSS — Indicates that the loop-down code is lost.

LOOP UP DETECT — Indicates that the loop-up code is detected.

LOOP UP DURA — Indicates the number of seconds from the time the loop-up code starts until it stops.

LOOP UP LOSS — Indicates that the loop-up code is lost.

NEW CONFIGURATION — Indicates a change in status of any major switch.

ONES DENSITY — Indicates whether the Ones Density LED is ON or OFF. This message is not applicable when the QRSS, 2^15-1, 2^20-1, 2^23-1, or 3 IN 24 data patterns are selected.

PATT LOSS — Followed by a count of the number of such occurrences during the test.

PATT SYNC ACQUIRED — Indicates pattern synchronization is acquired.

PULSE SHAPE — Indicates whether the Pulse Shape LED is ON or OFF.

SIG LOSS — Followed by a count of the number of such occurrences during the test.

SIGNAL DETECT — Indicates that the signal is detected.

TEST COMPLETE — Indicates when a timed test is completed (in lieu of printing an entire results print). This alarm message applies only when in TIMED TEST mode and the **PRINT EVENT** switch is in a position other than TEST END.

TEST RESTART — Indicates when the **RESTART** switch or any major switch is pressed.

NOTE The term major switch applies to the **PATTERN, MODE, RESTART, POWER, TIMING,** and **RECEIVE INPUT** switches, and the AUX HLT/CONT and AUX RESPONSE functions.

YELLOW ALM — Indicates whether the Yellow Alarm LED is ON or OFF.

B.3 FRONT-PANEL MESSAGES

Operating messages provide visual indications of the condition of the instrument and the received signal. Some messages appear once and others flash until the cause of the condition is changed or corrected. The messages are defined in alphabetical order as follows:

ALL RESULTS OK — When all summary results are error-free or meet specification boundaries (e.g., RX FREQ Hz and PULSE SHAPE), this message appears.

ALL RESULTS UNAVAILABLE — Displayed at test restart when the instrument has not synchronized with the received signal.

SIGNAL LOSS — The received signal has been lost. The receiver status LEDs are not illuminated, and the Alarm status LEDs are illuminated.

FAILED PATTERN — Indicates the failed test patterns when performing a BRIDGTAP or MULTIPAT test. The failed pattern is also indicated.

B8ZS DETECTED — Indicates the presence of B8ZS coding in the received signal when the **CODE** switch is set to the AMI position.

NOT B8ZS COMPATIBLE — Indicates the received signal is not B8ZS compatible when transmitting B8ZS encoded ALL ZEROS.

B.4 REMOTE CONTROL MESSAGES

The following error and warning messages appear when entering commands and/or parameters incorrectly. Error messages are formatted with the prefix **ERROR** or **WARNING** and the message indicating the problem.

ERROR: ***BAUD is not an executable command.*** — You attempted to change the baud rate in remote control mode.

ERROR: ***Burst length set to single.*** — You attempted to insert a burst of logic or BPV errors with the ERR SEL auxiliary function set to SINGLE.

ERROR: ***Can't continue.*** — You attempted to continue either a BERD-BASIC program that has been altered (i.e., lines have been changed) since the last **STOP** command.

ERROR: ***Characters after statement end.*** — The T-BERD 209A found additional characters at the end of a valid command.

ERROR: ***Command not allowed in program.*** — Your BERD-BASIC program contains a command which is only executable as a direct command from the remote controller.

ERROR: ***Command only allowed in program.*** — You attempted to execute a command from the remote control which is only executable in a BERD-BASIC program.

ERROR: ***DATA BITS is not an executable command.*** — You attempted to change the data bit setting in remote control mode.

ERROR: ***Illegal delimiter.*** — A delimiter (colon (:), comma (,), etc.) which is required in command syntax is not found.

ERROR: ***Illegal line number.*** — A non-existent BERD-BASIC program line is referenced (e.g., by a **GOTO** command) or you entered a program line with a value greater than 29779.

ERROR: ***Illegal value.*** — The value supplied with the command is outside the valid range for the function requested.

ERROR: ***Macros nested more than 5 deep.*** — A macro is attempting to recall itself or another macro more than five times.

ERROR: ***Must be specified by a parameter.*** — You did not specify a parameter that is required for command execution.

ERROR: ***Parameter is out of range.*** — You specified a parameter value that is outside the valid range (e.g., supplying the value 32 for the day of the month).

ERROR: ***PARITY is not an executable command.*** — You attempted to change parity value in remote control mode.

ERROR: ***Program memory overflow.*** — You entered a BERD-BASIC program that is too long to fit into memory.

ERROR: ***Result is not applicable to mode.*** — The T-BERD 209A is in a mode in which the requested result is not applicable.

ERROR: ***Result is not available.*** — You requested a result whose value cannot be computed. This condition can occur when the T-BERD 209A is out of frame or pattern synchronization and a result is specified that is only available when the T-BERD 209A is in frame or pattern synchronization.

ERROR: ***RS-232 Receiver buffer overflow.*** — A command is greater than 512 characters in length or commands were entered too quickly.

ERROR: ***RS-232 Receiver framing error.*** — The T-BERD 209A detects one or more asynchronous framing errors in the input command. This may occur if the controller's data format is different from that of the T-BERD 209A.

ERROR: ***RS-232 Receiver overrun error.*** — The remote control device is sending characters to the T-BERD 209A while the Clear To Send (CTS) control signal is OFF (false), indicating that the T-BERD 209A is not ready for more data. Solution: respond to signaling.

ERROR: ***RS-232 Receiver parity error.*** — The T-BERD 209A received one or more characters with a parity error.

ERROR: ***There is no such page for help information.*** — You requested information beyond the number of pages available for a HELP activity. Suggestion: issue the **HELP 1** command to learn how many pages of HELP information are currently available.

ERROR: ***Timing must be INT when in SELF TEST mode.*** — You attempted to change the timing source to a selection other than internal (INT) while in SELF TEST mode.

ERROR: ***Unrecognized command.*** — The T-BERD 209A does not recognize the command name entered in the command line.

ERROR: ***Unrecognized parameter.*** — The T-BERD 209A recognizes the requested command, but cannot interpret the specified command parameter.

WARNING: External clock is not present. — Though specified in the **TIMing** command, an external clock source is not present. In such instances, timing is taken from the T-BERD 209A internal clock source.

WARNING: Value has been rounded down. — To be processed, the command value that you entered has been rounded to the nearest allowable lesser value (see the **BURst LENgth** command).

APPENDIX C
STRESS PATTERNS

STRESS PATTERNS

A hexadecimal-to-binary conversion table appears below. The following test pattern bit patterns and hexadecimal equivalents are indicated in this appendix.

- T1 DALY
- T1-2/96
- T1-3/54
- T1-4/120
- T1-5/53
- 55 OCTET
- MIN/MAX

Hexadecimal-to-Binary Conversion

H	8421
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111
MSB LSB 74H = 0111 0100	

Min/Max Stress Pattern

01	02	03	04	05	06	07	08	09	10
80H	80H	80H	80H	01H	00H	01H	01H	01H	03H
1000 0000	1000 0000	1000 0000	1000 0000	0000 0001	0000 0000	0000 0001	0000 0001	0000 0001	0000 0011
11	12	13	14	15	16	17	18	19	20
80H	01H	80H	01H	01H	80H	01H	22H	00H	20H
1000 0000	0000 0001	1000 0000	0000 0001	0000 0001	1000 0000	0000 0001	0010 0010	0000 0000	0010 0000
21	22	23	24	25	26	27	28	29	30
22H	00H	20H	AAH	AAH	AAH	AAH	AAH	55H	55H
0010 0010	0000 0000	0010 0000	1010 1010	1010 1010	1010 1010	1010 1010	1010 1010	0101 0101	0101 0101
31	32	33	34	35	36	37	38	39	40
55H	55H	AAH	AAH	AAH	AAH	55H	AAH	AAH	55H
0101 0101	0101 0101	1010 1010	1010 1010	1010 1010	1010 1010	0101 0101	1010 1010	1010 1010	0101 0101
41	42	43	44	45	46	47	48	49	50
55H	55H	80H	80H	FFH	FFH	FFH	FFH	FFH	FFH
0101 0101	0101 0101	1000 0000	1000 0000	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111
51	52	53	54	55	56	57	58	59	60
FFH	FEH	FFH	FFH	24H	49H	92H	88H	88H	88H
1111 1111	1111 1110	1111 1111	1111 1111	0010 0100	0100 1001	1001 0010	1000 1000	1000 1000	1000 1000
61	62	63	64	65	66	67	68	69	70
10H	42H	08H	21H	84H	20H	08H	82H	40H	20H
0001 0000	0100 0010	0000 1000	0010 0001	1000 0100	0010 0000	0000 1000	1000 0010	0100 0000	0010 0000
71	72	73							
10H	80H	- -							
0001 0000	1000 0000								

T1-2/96 Stress Pattern

01	02	03	04	05	06	07	08	09	10
FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH
1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111
11	12	13	14	15	16	17	18	19	20
FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH
1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111
21	22	23	24	25	26	27	28	29	30
FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH
1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111
31	32	33	34	35	36	37	38	39	40
FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH
1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111
41	42	43	44	45	46	47	48	49	50
FFH	FFH	FFH	FFH	FFH	FFH	FFH	FFH	AAH	AAH
1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1111 1111	1010 1010	1010 1010
51	52	53	54	55	56	57	58	59	60
AAH	AAH	80H	01H	80H	01H	80H	01H	80H	01H
1010 1010	1010 1010	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001
61	62	63	64	65	66	67	68	69	70
80H	01H	80H	01H	80H	01H	80H	01H	80H	01H
1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001
71	72	73	74	75	76	77	78	79	80
80H	01H	AAH	AAH	AAH	AAH	80H	01H	80H	01H
1000 0000	0000 0001	1010 1010	1010 1010	1010 1010	1010 1010	1000 0000	0000 0001	1000 0000	0000 0001

T1-2/96 Stress Pattern (Continued)

81	82	83	84	85	86	87	88	89	90
80H	01H	80H	01H	80H	01H	80H	01H	80H	01H
1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001

91	92	93	94	95	96
80H	01H	80H	01H	80H	01H
1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001

T1-3/54 Stress Pattern

01	02	03	04	05	06	07	08	09	10
01H	01H	01H	01H	01H	01H	00H	01H	01H	01H
0000 0001	0000 0001	0000 0001	0000 0001	0000 0001	0000 0001	0000 0000	0000 0001	0000 0001	0000 0001
11	12	13	14	15	16	17	18	19	20
01H	01H	01H	03H	01H	01H	01H	01H	07H	01H
1000 0000	0000 0001	0000 0001	0000 0011	0000 0001	0000 0001	0000 0001	0000 0001	0000 0111	0000 0001
21	22	23	24	25	26	27	28	29	30
01H	01H	01H	55H	55H	55H	55H	AAH	AAH	AAH
0000 0001	0000 0001	0000 0001	0101 0101	0101 0101	0101 0101	0101 0101	1010 1010	1010 1010	1010 1010
31	32	33	34	35	36	37	38	39	40
AAH	01H	01H	01H	01H	01H	01H	FFH	FFH	FFH
1010 1010	0000 0001	0000 0001	0000 0001	0000 0001	0000 0001	0000 0001	1111 1111	1111 1111	1111 1111
41	42	43	44	45	46	47	48	49	50
FFH	FFH	FFH	80H	01H	80H	01H	80H	01H	80H
1111 1111	1111 1111	1111 1111	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000
51	52	53	54						
01H	80H	01H	80H						
0000 0001	1000 0000	0000 0001	1000 0000						

T1-4/120 Stress Pattern

01 FFH 1111 1111	02 FFH 1111 1111	03 FFH 1111 1111	04 FFH 1111 1111	05 FFH 1111 1111	06 FFH 1111 1111	07 FFH 1111 1111	08 FFH 1111 1111	09 FFH 1111 1111	10 FFH 1111 1111
11 FFH 1111 1111	12 FFH 1111 1111	13 FFH 1111 1111	14 FFH 1111 1111	15 FFH 1111 1111	16 FFH 1111 1111	17 FFH 1111 1111	18 FFH 1111 1111	19 FFH 1111 1111	20 FFH 1111 1111
21 FFH 1111 1111	22 FFH 1111 1111	23 FFH 1111 1111	24 FFH 1111 1111	25 FFH 1111 1111	26 FFH 1111 1111	27 FFH 1111 1111	28 FFH 1111 1111	29 FFH 1111 1111	30 FFH 1111 1111
31 FFH 1111 1111	32 FFH 1111 1111	33 FFH 1111 1111	34 FFH 1111 1111	35 FFH 1111 1111	36 FFH 1111 1111	37 FFH 1111 1111	38 FFH 1111 1111	39 FFH 1111 1111	40 FFH 1111 1111
41 FFH 1111 1111	42 FFH 1111 1111	43 FFH 1111 1111	44 FFH 1111 1111	45 FFH 1111 1111	46 FFH 1111 1111	47 FFH 1111 1111	48 FFH 1111 1111	49 FFH 1111 1111	50 FFH 1111 1111
51 FFH 1111 1111	52 FFH 1111 1111	53 FFH 1111 1111	54 FFH 1111 1111	55 FFH 1111 1111	56 FFH 1111 1111	57 FFH 1111 1111	58 FFH 1111 1111	59 FFH 1111 1111	60 FFH 1111 1111
61 FFH 1111 1111	62 FFH 1111 1111	63 FFH 1111 1111	64 FFH 1111 1111	65 FFH 1111 1111	66 FFH 1111 1111	67 FFH 1111 1111	68 FFH 1111 1111	69 FFH 1111 1111	70 FFH 1111 1111
71 FFH 1111 1111	72 FFH 1111 1111	73 AAH 1010 1010	74 AAH 1010 1010	75 AAH 1010 1010	76 AAH 1010 1010	77 10H 0001 0000	78 10H 0001 0000	79 10H 0001 0000	80 10H 0001 0000

T1-4/120 Stress Pattern (Continued)

91 10H 0001 0000	92 10H 0001 0000	93 10H 0001 0000	94 10H 0001 0000	95 10H 0001 0000	96 10H 0001 0000	97 10H 0001 0000	98 10H 0001 0000	99 10H 0001 0000	100 10H 0001 0000
101 10H 0001 0000	102 10H 0001 0000	103 10H 0001 0000	104 10H 0001 0000	105 10H 0001 0000	106 10H 0001 0000	107 AAH 1010 1010	108 AAH 1010 1010	109 AAH 1010 1010	110 AAH 1010 1010
91 10H 0001 0000	92 10H 0001 0000	93 10H 0001 0000	94 10H 0001 0000	95 10H 0001 0000	96 10H 0001 0000	97 10H 0001 0000	98 10H 0001 0000	99 10H 0001 0000	100 10H 0001 0000
101 10H 0001 0000	102 10H 0001 0000	103 10H 0001 0000	104 10H 0001 0000	105 10H 0001 0000	106 10H 0001 0000	107 10H 0001 0000	108 10H 0001 0000	109 10H 0001 0000	110 10H 0001 0000

T1-5/53 Stress Pattern

01	02	03	04	05	06	07	08	09	10
80H	01H	80H	01H	80H	01H	80H	01H	80H	01H
1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001
11	12	13	14	15	16	17	18	19	20
80H	01H	80H	01H	80H	01H	80H	01H	80H	01H
1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001
21	22	23	24	25	26	27	28	29	30
80H	01H	80H	01H	80H	01H	80H	01H	80H	01H
1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001
31	32	33	34	35	36	37	38	39	40
01H	AFH	AAH	AFH	01H	01H	01H	01H	FFH	FFH
0000 0001	1010 1111	1010 1010	1010 1111	0000 0001	0000 0001	0000 0001	0000 0001	1111 1111	1111 1111
41	42	43	44	45	46	47	48	49	50
FFH	FFH	01H	01H	01H	01H	FFH	FFH	FFH	FFH
1111 1111	1111 1111	0000 0001	0000 0001	0000 0001	0000 0001	1111 1111	1111 1111	1111 1111	1111 1111
51	52	53							
FFH	FFH	CBH							
1111 1111	1111 1111	1100 1011							

55 OCTET Stress Pattern

01 01H 0000 0001	02 01H 0000 0001	03 01H 0000 0001	04 01H 0000 0001	05 01H 0000 0001	06 01H 0000 0001	07 00H 0000 0000	08 01H 0000 0001	09 01H 0000 0001	10 01H 0000 0001
11 01H 0000 0001	12 01H 0000 0001	13 01H 0000 0001	14 03H 0000 0011	15 01H 0000 0001	16 01H 0000 0001	17 01H 0000 0001	18 01H 0000 0001	19 07H 0000 0111	20 01H 0000 0001
21 01H 0000 0001	22 01H 0000 0001	23 01H 0000 0001	24 55H 0101 0101	25 55H 0101 0101	26 55H 0101 0101	27 55H 0101 0101	28 AAH 1010 1010	29 AAH 1010 1010	30 AAH 1010 1010
31 AAH 1010 1010	32 01H 0000 0001	33 01H 0000 0001	34 01H 0000 0001	35 01H 0000 0001	36 01H 0000 0001	37 01H 0000 0001	38 FFH 1111 1111	39 FFH 1111 1111	40 FFH 1111 1111
41 FFH 1111 1111	42 FFH 1111 1111	43 FFH 1111 1111	44 80H 1000 0000	45 01H 0000 0001	46 80H 1000 0000	47 01H 0000 0001	48 80H 1000 0000	49 01H 0000 0001	50 80H 1000 0000
51 01H 0000 0001	52 80H 1000 0000	53 01H 0000 0001	54 80H 1000 0000	55 01H 0000 0001					

T1-DALY Stress Pattern

01	02	03	04	05	06	07	08	09	10
01H	01H	01H	01H	01H	01H	80H	01H	01H	01H
0000 0001	0000 0001	0000 0001	0000 0001	0000 0001	0000 0001	1000 0000	0000 0001	0000 0001	0000 0001
11	12	13	14	15	16	17	18	19	20
01H	01H	01H	03H	01H	01H	01H	01H	07H	01H
0000 0001	0000 0001	0000 0001	0000 0011	0000 0001	0000 0001	0000 0001	0000 0001	0000 0111	0000 0001
21	22	23	24	25	26	27	28	29	30
01H	01H	01H	55H	55H	55H	55H	AAH	AAH	AAH
0000 0001	0000 0001	0000 0001	0101 0101	0101 0101	0101 0101	0101 0101	1010 1010	1010 1010	1010 1010
31	32	33	34	35	36	37	38	39	40
AAH	01H	01H	01H	01H	01H	01H	FFH	FFH	FFH
1010 1010	0000 0001	0000 0001	0000 0001	0000 0001	0000 0001	0000 0001	1111 1111	1111 1111	1111 1111
41	42	43	44	45	46	47	48	49	50
FFH	FFH	FFH	80H	01H	80H	01H	80H	01H	80H
1111 1111	1111 1111	1111 1111	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000	0000 0001	1000 0000
51	52	53	54	55					
01H	80H	01H	80H	01H					
0000 0001	1000 0000	0000 0001	1000 0000	0000 0001					

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